TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

VOL. VI No. 6. JUNE, 1929. PRICE 6d.

CONTENTS.

	PAGE.
Colonial Advisory Council	157
Agriculture in Mauritius	159
Agriculture in South Africa	160
Biological Control	163
Vitamins (concluded)	166
Kapok	169
Carbohydrates in plants	170
The Date Palm	172
Cacao Note	174
Crops Products Manufacture	174
Tea Root Infection	175
Sugar Outlook for 1929	176
Pedigree Stock	176
Fertile Soils	177
American Cotton Crop	177
Tropical World Notes	178
Reviews	179
Chemical Notes	180
Sugar Notes	181
Topping of Coffee	182
College News	182
Easter tour to St. Lucia	183
Tanganyika Territory	183
Trend of the Markets	184

THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

Cables :: "Stomata." | Phone :: 1983.

TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed in signed articles are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

COLONIAL ADVISORY COUNCIL.

IN HIS opening address as Chairman of the first meeting of the Colonial Advisory Council of Agriculture and Animal Health which was held at the end of March, Mr. Ormsby Gore outlined the functions of the Council and showed clearly that its future activities will have a direct and important bearing on the agricultural development of our Colonial Empire. The Council, as will be remembered, was appointed in accordance with the recommendations submitted by two Committees over which Lord Lovat presided, the one on the organisation of a Colonial Agricultural Service and the other on the Colonial Veterinary Service. It is gratifying to note that twenty-one of the twenty-six Dependencies, or groups of Dependencies, which were asked to co-operate in the establishment of the Council, have so far agreed to do so. The Council have received no detailed terms of reference but the functions which it is proposed that they should perform will follow, in general, those recommended by the two Committees. Their duty will be to advise both the Secretary of State and Colonial Governments on any problems connected with agriculture and animal health that may be referred to them and to be available for consultation on any matters on which their help and assistance will be required.

Of the Council's present personnel Mr. Ormsby Gore's appointment as Chairman is, it is understood, temporary and he will only act until he can be replaced by a layman familiar with the problems available. While the appointment of Chief Agricultural Adviser is being left unfilled, the services of Mr. F. A. Stockdale have been secured as Vice-Chairman and as Assistant Agricultural Adviser. The members of the Council will be required to serve in their personal capacity and not as directors of their respective institutions, while their successors in office will not necessarily succeed on this body. It has been agreed to keep the membership of the Council as small as possible although, no doubt, it will be necessary to make additions from time to time, the Council having been given the power to co-opt members as required. No steps will be taken to appoint the two Committees of Agriculture and Animal Health, on whom it was anticipated that the main work of the Council would fall but these Committees will no doubt, be found necessary in the future.

The Council, in its discussions, is instructed to keep in view the reports of the Committees

which in the past few years have studied questions relating to agriculture and the agricultural services in the Colonial Empire. Amongst these is mentioned the report of the Committee on the organisation of a Colonial Agricultural Service which recommended the establishment of the Council and the new appointments already referred to. With reference to the recent report of the Colonial Veterinary Service it is proposed that the first step to be taken on the report is to initiate, without delay, the scholarship scheme which the Committee have recommended for the training of veterinary officers, provided the necessary support be forthcoming.

The appointment of the Council, says Mr. Ormsby Gore, marks another stage in the Government's efforts to assist Colonial development as similar bodies, such as the Colonial Medical Research Committee and the Advisory Committee on Education in the Colonies have already been appointed to advise the Secretary of State on questions affecting medical research, public health and education. It is anticipated that the experience gained by these Committees will be made full use of by the Council, especially with regard to the very important subject of the dissemination and interchange of information. The Council will have to consider how best to supplement and co-ordinate the work of the Imperial Bureaux of Entomology and Mycology and of the eight new Imperial Bureaux which are being established as a result of the recommendations of the 1927 Imperial Agricultural Research Conference. So far, nineteen Colonial Governments have agreed to contribute towards the cost of the establishment and maintenance of these new Bureaux, £2,495 having already been collected towards the £3,750 which the Colonial Empire as a whole was asked to contribute. Mr. Vernon has been appointed by the Secretary of State to represent the Colonies generally upon the Executive Council of the new Bureaux and Mr. Stockdale will act as the official correspondent with all of them for the Colonial Empire.

Of the other major problems to be tackled by the Council will be the consideration of periodical reviews of agricultural research work and development in the Colonial Empire. In that connection, Mr. Stockdale has already proposed to put together a short review of the Report of the Royal Commission on Agriculture in India. This review will bring out those points of special interest to the Colonies and will be printed and circulated to Colonial Governments. As a further general review of the policy of the proposed chain of Central Research Stations is desirable, it is suggested that the Council should put forward views on the lines on which future development should take place. Progress in this direction cannot be rapid as the supply of workers is limited, but it is claimed that a good start has been made with the East African Agricultural Research Station at Amani. Special attention is also drawn to Mr. Engledow's visit to Trinidad which was arranged by the Empire Marketing Board for the purpose of discovering the part that the Imperial College of Tropical Agriculture should play as (*a*) a training centre for the Colonial Agricultural Services, (*b*) a link in the Imperial chain of Research Stations and (*c*) its duty towards West Indian Agriculture.

Then, there are the non-Government research institutions or the privately endowed schemes for research work in rubber, tea and coconut industries in both Malaya and Ceylon which, in Mr. Ormsby Gore's opinion, should co-operate with and supplement the work of the Departments of Agriculture in those countries and have their proper place in the conception of co-ordinated research for the agricultural industries of the Colonial Empire as a whole. It is also suggested that the research work of the Empire Cotton Growing Corporation in the Colonies should be closely associated with that of the Agricultural Departments of cotton-producing Dependencies. The advice of the Council will be sought on the allocation of research programmes into particular crops such as cacao and coconuts and to decide as to which work is best suited to each Dependency where various forms of such research are being undertaken, so as to avoid overlapping and unnecessary duplication of effort. The further development of the work on Animal and Human Nutrition which is being conducted in Kenya in collaboration with the Rowett Research Institute at Aberdeen will also need to be considered. A question of extreme complexity will be that of the recent proposals for the unification of the Colonial Agricultural Services in the light of the criticisms and observations submitted by several Colonial Governments. Although unification is the ideal to be aimed at and, in principle, has been generally accepted, it will, however, be very necessary for the Council to give most careful thought and consideration to the difficulties which surround its inauguration.

The Council will have to work in the closest harmony with the Empire Marketing Board and their Research Grants Committee. The Board have been remarkably generous in the assistance which they have willingly given towards the prosecution and development of research in the Colonies and through them the Council will be able to keep in touch with some of the research work which is being done in other parts of the Empire. The Council will, it is expected, play some part at future Colonial Office and Imperial Agricultural Research Conferences and probably be asked to present some review of Colonial Agricultural development. A second Colonial Conference is timed to take place some time next year and there is no doubt that the question of a unified Agricultural Service will come up before this Conference. Before the meeting of the next Imperial Agricultural Research Conference which is to be held in Melbourne in 1932 it will be desirable to take early steps to organise some form of Colonial Group through which the individual Colonies can take a more leading part in the work of the main Conference

than was possible in 1927 and to examine in due course the proposals, that before the main Conference meets in Melbourne, that a Colonial Agricultural Conference, at least for the Tropical Dependencies, should be held. It will be remembered that the necessity for holding these group conferences was stressed in our issue of June, 1926. It was then pointed out that all our tropical colonies should receive direct representation at the Imperial Conference and not depend upon indirect representation by the Secretary of State for the Colonies. However sympathetic and well informed this Minister may be, he would not be in a position, for obvious reasons, to urge the claims of these colonies as cogently as those immediately connected with them. It is therefore gratifying to find that the idea of these group conferences is being mooted again as there is no doubt that they should prove "as beneficial to the Colonies immediately concerned as the Imperial Conferences have been to the Empire at large."

Thus has Mr. Ormsby Gore reviewed the work expected of the Council and after expressing his deep gratitude, on behalf of all those present, to Lord Lovat, for his invaluable services as Chairman of successive Committees he concluded his address by saying, "I should like to take this opportunity of placing once again on record my own opinion that the future prosperity not only of the Colonies themselves but also of Great Britain depends very largely on the increasing application of the results of scientific research to the problems of agricultural development. Though there are still large gaps in our knowledge which we must endeavour to find the best means of filling, there is a vast amount of experience not merely in the British Empire but in other Colonial Empires, and in the Universities and research centres of the whole world, which can be rendered more available to producers and workers if only that experience was more generally appreciated and widely known.

It is to the desire of the Secretary of State that the Colonial Office shall make itself ever more useful to all communities in the Colonial Empire that this Council owes its origin. We therefore hope that a long career of useful work is before it, and that it will earn the regard and appreciation of all who have the welfare of the Colonies at heart."

BAKER MEMORIAL PROFESSORSHIP.

We are informed that the Board of Regents of the University of the Philippines has established a Baker Memorial Professorship in the College of Agriculture, in memory of the exceptional services rendered by Charles Fuller Baker, who was dean of the College of Agriculture from 1917 until his death in July, 1927.

The professorship provides for the services in the College of a man from abroad who is a specialist in the different sciences allied to agriculture and who shall be in residence eight months at least in the College, and shall teach five hours a week.

AGRICULTURE IN MAURITIUS.

Progress Report, October to December, 1928.

M. Koenig,
Statistician.

Sugar.—Temperature was markedly below normal during the three months under review and rainfall was generally deficient. As a result, the young ratoon canes have been suffering appreciably. Grinding was completed early in December. Weather conditions during the grinding season having proved exceptionally favourable to milling operations the purity of the juice was high and the recovery of sugar exceptionally large. The preliminary compilation of the sugar production for last campaign gave a total of 251.1 thousand metric tons—a figure markedly above the average of the past seven years and considerably above expectation. In view of the unsatisfactory market conditions for granulated whites (vesous) an unusually large proportion of raws was turned out this year—approximately one-fourth of the total production. The market conditions have been the worst since 1913 and, to cope with the difficulties in which many sugar concerns found themselves, Government consented to a loan of Rs. 7 million to planters, to be repaid by means of an export tax on sugar. Considerable funds have been absorbed in the campaign against *Phytalus Smithi.* This pest has proved this year, more than usually active.

Tobacco.—Marked progress in the cultivation of tobacco has been in evidence during the past three months and the area under this crop, which, for reasons quoted in the previous report, had shrunk to 200 acres, has now risen to about 1,100 acres.

Other Agricultural Industries.

The market for fibre improved considerably: quotations for "Prime" being Rs. 410 per ton, while "good" reached Rs. 380. About 2,500 tons were exported during the year of a total value approximating to Rs. 843,500, *c.i.f.*

In relation to fruit canning and preserving, no further progress has taken place. A remodelling of the original terms of which the association of growers was expected to be formed, is contemplated and further assistance from Government expected.

There are, at present, five distilleries at work in the Island. The largest, annexed to Medine Factory produces rum, power spirit and ethers for pharmaceutical and other purposes. The total production of rum during the year approximated to 700,000 litres.

There has been recently some revival of the tea industry. Application for financial help from Government has been received, but there is little likelihood of local teas being able to compete with foreign teas especially Ceylon's.

Efforts are being made to develop oil industries, from coprah, obtained from the Dependencies of Mauritius and groundnuts. Government has, recently, received application for financial help in this connection.

AGRICULTURE IN SOUTH AFRICA.

By Sir Francis Watts, D.Sc.

[*Being Extracts from an Address illustrated by lantern slides delivered to the Trinidad Science Club in February*, 1929.]

To one accustomed to the agricultural conditions of the West In ies there are several features in South Africa that strike one forcibly. First of all there is the relative shortage of water. South Africa, on the whole, is a dry country and the rainfall is divided pretty sharply into that of the dry winter period, May to O tober, when, over the greater part of the Union, less than five inches fall, and that of the summer period when the better watered regions get 30 to 40 inches; some get 20 to 30, but there are large tracts getting only 10 to 20, some only 5 to 10 inches, while there are large areas along the western side of the country where the summer rain is less than 5 inches and that of the whole year is under 10 inches. Another striking feature is the extensive character of agricultural operations as contrasted with the intensive methods of the West Indies and Great Britain.

Except in districts where irrigation is possible agricultural operations have to be adapted to the seasonal rainfall: during the dry winter period many operations have to be suspended, the grain crops are sown so as to take advantage of the summer rains.

With all its limitation as regards rain, South Africa is a great agricultural country; the value of agricultural products being upwards of £67,000,000. Animal husbandry is of much importance. Great quantities of sheep are raised, mainly for their wool, which is of very fine quality, and cattle are produced in great numbers, being used for draught purposes, also for their meat and hides which are important articles of commerce, while dairying is carried on, on a considerable and increasing scale, large quantities of milk being required to meet the demands of the large towns, while butter and cheese are produced for home consumption and also for export on a large scale.

Maize Production.

On the arable side maize forms the main object of cultivation, it is the crop of preponderating importance in South Africa, the total production of grain being about two and a half million tons (1924-25), which taken at a moderate valuation of £6 5*s.* 0*d.* a ton, is equivalent to £15,400,000. Of this some 60 per cent. is consumed in the country and some 40 per cent. exported in the form of grain and meal.

Maize is grown in almost every district of the Union; the most important producing area lying within what is known as the Maize Triangle, which may be defined by a line drawn from Mafeking in Bechuanaland to Machadadorp in the Transvaal and completing the triangle by lines connecting these extremities with Zastron in the Orange Free State. Some 60 per cent. of the Union's production comes from within this area and it is practically all produced by Europeans. Of the remaining 40 per cent. grown outside this triangle about 20 per cent. is produced by native tribes, principally in the Transkeian Territories, Zululand and Swaziland. A considerable quantity is produced in the Northern Transvaal, also in the midlands of Natal and in the Eastern districts of the Cape Province between East London and Queenstown.

The cultivation of the crop is restricted to the period of the summer rains, 15th December being commonly regarded as the latest date for sowing. Under favourable circumstances a good deal of work can be done before the advent of the rains by way of weeding and cleaning the land and preparing it for sowing, thus minimising the subsequent work of weeding and cultivating. The land is ploughed with oxen as these are abundant and largely used for draught purposes; they are also used for drawing harrows, cultivators and planters; in a few cases only are horses used for these purposes.

The crop is usually reaped by hand, the stover being used for fodder, the cattle being either turned into the fields to eat it down, or it may be cut and fed to the stock. Shelling, or cleaning the grain from the cob is done by machinery, usually by contract with the owners of the machines.

Attention is now being paid to the use of fertilisers and considerable use is made of farmyard manure.

Apart from the use of the maize on the farms very large quantities are required for the use of the kaffir labourers in the gold mines of Johannesburg, the diamond mines of Kimberley and the coal mines of the Transvaal and Natal.

Approximately one million tons of maize are exported in the form of grain and meal.

Careful organisation is required for the handling of these large quantities and much has been done in this direction by the development of the elevator system at the hands of the Government, under the immediate control of the Department of Railways and Harbours. Under this system grain is received from the producers, cleaned, graded and stored. On receipt a certificate is issued for the quantity and quality of the grain received and this document can be used as security against a bank advance, or it can be sold outright; by this system financial operations are greatly facilitated. As the grain is handled in bulk the cost of bags is eliminated and the cost of loading into railway trucks and steamships is greatly reduced.

At present there are 34 elevators distributed through the principal maize producing districts. These elevators vary in storage capacity from 1,800 tons to 5,800 tons, the aggregate being 109,200 tons; in addition to these there are two large elevators at Capetown and Durban, that at Capetown having a capacity of 30,000 tons and the one at Durban 58,000 tons, the total storage capacity of the system being 181,200 tons.

The working of the elevator system has not been free from difficulty and has been carried on at considerable loss to the Government.

AGRICULTURE IN SOUTH AFRICA.

Dairy Cattle, Potchefstroom.

Another Dairy Herd.

AGRICULTURE IN SOUTH AFRICA.

Flock of Merino Sheep.

Flock of Angora Goats.

Complaints are made that some owners of grain take undue advantage of the system to hold their grain in the elevators waiting for a rise in price and thus prevent their legitimate use in the ordinary way of handling the product. It has been suggested that higher charges may have to be made for storage after the first ten days so as to discourage this improper use.

Kaffir Corn.

A considerable quantity of Kaffir Corn (*Sorghum vulgare*) is grown by the natives. This indigenous plant is receiving attention from the European farmers on account of its value as a fodder and for its use for making ensilage. The grain is useful as food both for men and animals. The varieties now grown are improved ones introduced from America. A considerable quantity is used for making Kaffir beer, of which great quantities are consumed by the natives. This is a slightly fermented, turbid liquid, slightly acid containing less than 2 per cent. of alcohol.

Other Crops.

Of the other crops wheat is grown to a small extent, mainly in the South-western and Queenstown Provinces of the Cape Province and in the "Conquered Territory" of Basutoland (3,000 sq. m). The yield is but small, averaging about 8½ bushels of 60 lb. per acre. It may reach double that amount on irrigated lands of the Karoo.

Barley and oats are also grown in considerable quantity. In addition to the grain, much of the oat crop is cut while green and used for hay.

The value and importance of the Lucerne crop is being increasingly recognised. Formerly grown in great quantities as fodder for ostriches, largely in the southern and eastern parts of the Cape Province, great fortunes were made in certain irrigated districts. It has been said that "since 1923, and before the loss of the ostrich industry, Lucerne has made more fortunes than any other product, except gold or diamonds." It is now largely used to supplement food supply in dry seasons; on good irrigated land it is cut for hay and also grazed off by pigs without damage to the crop.

Cattle Industry.

Cattle raising forms a very important branch of South African agriculture. It is estimated that there are between nine and ten million head in the Union; nearly one-half of which belong to natives, who from time immemorial have raised herds under conditions closely akin to those of modern ranching, which consist in running herds over extensive pastures allowing them to roam almost at will, though herdsmen look after their movements, care being taken to provide such water as the districts afford, and as far as possible to direct their movements to the best available feeding grounds.

Ranching is largely followed by European stock owners on the grass lands of the Kalahari, many hundreds of square miles of which occur mainly to the east and north of Kimberley, in the Bechuanaland protectorate, where the winter rainfall is under 5 inches and that of the summer period reaches only 10 to 20 inches. For the most part these Kalahari grass lands require from 20 to 40 acres for each head of stock, but better grazing lands are met with as one approaches the border of the Transvaal, though even here from 10 to 20 acres are required. Grazing conditions improve as one follows the boundaries of the Transvaal along the drainage areas of the Crocodile or Limpopo River, the better lands supporting one animal on less than 10 acres.

Constant efforts are made to improve the stock-carrying of these areas, particularly of those more favourably situated. These efforts take the form of improved water conservation and attention to the pastures, including the introduction of good fodder grasses and work of that kind. As one approaches the better lands the farms improve until dairy farming and mixed agriculture become possible when conditions approximate more closely to those of Europe.

These cattle raising areas lie mainly along the eastern and northern borders of what has been referred to as the great maize bearing tract and even in the better farms encroach within that area.

The cattle run on these ranches are mostly of the native long-horned type which the early settlers found the Hottentots possessed of when they arrived in the country at the close of the seventeenth century. From the outset the Dutch have endeavoured to improve the native races by the introduction of good strains from Holland, and it is interesting to note that the best of this foundation stock owes its origin to imported cows looted by the Hottentots from Dutch settlers in the neighbourhood of Mossel Bay in 1668. These animals are those found most suitable for transport purposes on account of their hardiness and resistance to disease.

The transport ox has been of fundamental importance in South African settlement and development. From the early days the Dutch farmers were entirely dependent on the ox-waggon for all means of transport. In the remoter districts, roads, as one ordinarily understands the term, are non-existent, there being only unmetalled tracks crossing the veld; the ox-waggon can travel over these with impunity. In spite of the development of railway and motor haulage, cattle are still largely employed for transporting produce and goods to and from the railway centres and the farms and remote districts. In addition to transport purposes the ox is valuable also for beef and for hides.

The pastures of the lands devoted to ranching are too poor to enable the animals raised on them to be brought into good condition for market, consequently it is the custom on the part of ranchers to sell them to farmers situated either in or near the maize producing areas or where good crops of sorghums (Kaffir corn) and other fodders can be raised; this work is carefully undertaken, and now constitutes an important branch of South African farming. The areas suitable for this work are for the most part in

the Transvaal and part of the Orange Free State where farming conditions are good and where good markets for beef exist in the mining districts of the Transvaal and northern Natal. In addition there is a large consumption of beef throughout the Union, so that special and well planned arrangements are made for marketing and cold storage; chilling and storing establishments being provided at several large towns.

Attention is being given to the establishment of an export trade in meat, but there is, so far, but a limited supply of beef of a quality required by the British market. An interesting development in this connexion has been the opening up by the Imperial Cold Storage of a market in Italy, shipments have also been sent to France.

The incidence of cattle disease, notably rinderpest in 1896, seriously retarded the progress of cattle raising, hundreds of thousands of cattle died from 1896-98, but with the control of disease conditions are rapidly improving.

Dairy farming is receiving much attention and care is now being devoted to the creation of good dairy herds by the selection of good breeds and by the elimination of the less profitable milkers, the Government and the various Dairy Associations being active in all this.

It is in connexion with the raising of dairy stock that perhaps the greatest advance has been made, and particularly in the direction of producing high-class pedigree stock; the Government, the Shipping Companies and other organisations, including many prominent South Africans, have all actively collaborated in this work, until now South Africa is recognised as one of the finest and most important districts for the production of pedigree cattle.

Reverting to dairy work, there is a good demand for milk in all the large towns and steps are being taken to supply it on modern sanitary lines; help and instruction in this direction being afforded by the Government and the Agricultural Colleges and Schools, for example, the Glen School of Agriculture specialises in dairy work, as does also that at Potchefstroom. Creameries and butter factories are also to be found scattered throughout the country.

Sheep Industry.

Sheep farming is carried on over the greater part of the Union; it is the most general of all the South African farming enterprises, and South Africa is steadily taking its place as one of the great sheep and wool producing countries of the world. The country may be divided into three distinct sheep farming types of district, namely the Karoo, mixed veld and grass country.

The Karoo is an arid, or semi-arid region mostly within the Cape Province extending from the coastal plateau for many miles. The pasturage consist mainly of low shrubs which afford feeding for great flocks of sheep and goats. Further north lie the mixed veld lands on the western and south-western borders of the Orange Free State. These lands bear mixed pasture of Karoo bush and grass and have a higher carrying capacity than the Karoo. The grassland veld comprises the bulk of the pastoral area of the Union, it ranges from the coastal belt of the Western Province, the whole of the Eastern Province, Central and Eastern Orange Free State, the whole of the Transvaal and Natal.

The sheep are raised mainly for their wool and although South Africa has now become one of the important wool producing countries of the world, its output is capable of expansion and this expansion is being hastened by the failure of the ostrich industry and the consequent grazing of sheep over what were until recently ostrich farms.

Wool of good average quality is obtained from the greater part of the Union. Fine wools are produced in the Western and Eastern parts of the Cape Province, the Eastern Free State, the Eastern Transvaal, the whole of Natal and East Griqualand. The fine wools raised in the region around Grahamstown, Craddock and Colesberg are especially appreciated by English manufacturers, and active efforts are being made to improve their quality still further. Notable work in this connexion is being done under the direction of Dr. J. E. Duerden of the Rhodes University, Grahamstown, who is carefully studying wool and its growth on genetic lines and already important facts have been discovered having direct bearing on the production of fine wool and the remedying of defects.

In order to improve the breed of sheep large numbers of high-class animals have been imported. The production of high-class stud animals is now an important part of the South African sheep industry, enlightened sheep farmers paying great attention to the quality of their animals and the wool produced by them. Locally raised rams have brought prices ranging from 1,000 to 1,500 guineas. Thus, while the industry carries on in an extensive way, it is evident that money and intelligence are given to the industry in no stinted manner.

Goat Industry.

Angora goats, which produce the mohair of commerce, were introduced at great trouble and expense in 1838 from Cashmere and Asia Minor. The present flocks are the results of crosses between ordinary Boer ewe goats and high-class Angora rams. At present South Africa produces two-thirds of the world's supply of mohair, the remainder coming from Turkey.

* * *

Owing to lack of time it was not possible to deal with the sugar and fruit industries which are of great importance to South Africa, the object of the address being mainly to draw attention to the great differences that exist in South Africa farming with its characteristically low rainfall and the agriculture of the West Indies and many other tropical districts having higher rainfall.

BIOLOGICAL CONTROL.

The Principles of Biological Control.

BY J. G. MYERS, SC.D., F.E.S.,
Imperial Bureau of Entomology.

PROBABLY ninety-nine out of every hundred people, when they think of the contributions of science to human welfare, recall the physical, chemical and mechanical inventions which produced the industrial revolution and are now engaged in the mechanisation of the world, and in the evolution of its new master, the centaur of the new civilisation—that half-man, half-automobile, envisaged by that brilliant recent writer, Woodruff, in *Plato's American Republic.* We are not accustomed to think of *biological* inventions; by which we mean, with Haldane, "the establishment of a new relationship between man and other animals or plants, or between different human beings, provided that such relationship is one which comes primarily under the domain of biology, rather than physics, psychology, or ethics." The application of biology to the solution of human problems has as yet hardly begun. Haldane has shown that the number of great biological inventions can be counted on the fingers of one hand, and most of these were made before the dawn of history.

When mankind was at the hunting stage of culture, living only on animals and perhaps a few plants, secured with the aid of primitive tools, a Malthusian prophet might justly have envisaged, concurrently with improvement in weapons and in hunting technique, a gradual decrease and final extinction of the game, and with it the annihilation of the human race dependent thereon. It is improbable that he would have predicted the innovation—the first great biological invention, namely, the domestication of animals and plants—which was to save the future and ensure the continued evolution of man.

It is interesting to realise that until recent years there had not been, during the whole historic period, any noteworthy addition to the list of man's domestic animals. All had been the servants of man from the dawn of history, they had accompanied him out of the mists of antiquity and had materially assisted his emergence.

The principle of biological control involves a tremendous increase in the numbers of man's animal auxiliaries—it is, in fact, an extension of the first great biological invention—the domestication of animals. It is true that the animals thus utilised are usually not domestic animals in the strict sense of the term, but there exists every gradation between these and such closely-domesticated organisms as dairy-cows. Moreover, in what were in all probability among the first attempts at biological control—the destruction of rats and mice by dogs and cats—animals probably already domesticated were the agents. Ferrets, however, used against rats and rabbits, are very much less domesticated than dogs or cats and form a transition to natural enemies which are utilised without true domestication. It is these latter which are the chief agents in the biological control of insect pests.

The term "biological control" covers at the same time, a multitude of sins and a number of man's newest and most promising weapons in his struggle with the organic environment. We must carefully examine these, for with the increasing popularity of natural control methods it becomes more and more necessary to define clearly what reputable workers understand by "biological control," and to distinguish between what should be actually attempted in this sphere, and what must still remain the subject of cautious experimentation. The need is the more urgent from the fact that, as Thompson has recently emphasised, "economic entomology, though it finds in science its principles and its tools, is itself not so much a science as an art, like medicine. As in medicine, the practice of the art is always to some degree in advance of the written recipes and rules, which hardly do more than catalogue what experience has taught. One consequence of this is that while certain general methods gradually develop, there is a considerable period during which they can be learned only from the practitioners of the trade; another is that their general value remains uncertain until their scientific basis is critically examined. Such is at present the situation in regard to the biological control of insect pests . . ."

How, then shall we define "biological control?" In a sense any method of combating a pest by means other than direct chemical or physical ones, is biological. The breeding of immune varieties of plants is one such, very promising, means. We would, however, limit the term to the utilisation of one kind of organism for the limitation or destruction of another. The theoretical possibilities of such a method are, of course, extremely numerous, but we shall confine the following analysis to those cases in which attempts have been actually made or suggested. Even for these the accompanying table is not complete; but it will serve as a basis for discussion.

I. Control of Injurious animals.
  A.—By other animals.
    1. Control of nematodes by predacious nematodes (Steiner and Heinly, suggestion only, 1922).
    2. Control of molluscs by vertebrates (slugs and snails by birds, hedgehogs, &c.)
    3. Control of insects and other arthropods by
      (*a*) mites.
      (*b*) other insects.
      (*c*) birds.
      (*d*) other vertebrates (*e.g.*: fish and newts against mosquito larvae, toads against nocturnal insects, bats against mosquitoes).
    4. Control of vertebrates by other vertebrates (*e.g.*: fish by fish, snakes and rats by mongoose, rabbits by weasels, mice and rats by birds of prey).

B.—By plants.
1. Control of insects and other arthropods by
   (*a*) bacterial diseases.
   (*b*) parasitic fungi.
   (*c*) algae (*e.g.*: mosquito larvae by *Chara* spp.)
   (*d*) phanerogams (*e.g.*: scale-insects on lime trees diminished by allowing Bengal beans to climb over trees. Montserrat, Ballou). (*Melinis* grass against flies and ticks).
2. Control of injurious vertebrates by bacterial diseases (*e.g.*: rabbit in Australia, rats).

II. Control of injurious plants (Weeds) by
1. insects (*e.g.*: against prickly pear and *Lantana*).
2. mites (*e.g.*: against prickly-pear).
3. fungi (*e.g.*: against prickly-pear, blackberry, Californian thistle).
4. bacteria (*e.g.*: against prickly-pear).

In addition there are such border-line cases as that of d'Herelle's bacteriophage; and such indirect control as that of cattle flies by the utilisation of dung beetles, which render the manure unsuitable for their breeding.

Most of these cases represent actual attempts; a few are only suggestions. *As to their relative practicability, it cannot be too strongly emphasised that all are either in the experimental stage or may be dismissed as valueless, save the control of insects and other arthropods by insects.* It is far too frequently forgotten that this and this alone is the only sound general practice in biological control. To this must be credited every one of the sweepingly successful applications of the principle. Only when this method has failed after years of trial, should the introduction of natural enemies other than insects (or other arthropods) be contemplated. The introduction and acclimatization of predacious birds and mammals as a measure against pests (whether insect or vertebrate) has led to such disasters in the past, that it should be universally condemned. I need only mention the introduction of the mongoose into the West Indies, of the stoat and weasel into New Zealand, and of the English sparrow into North America and other parts of the world. So far as insect-eating birds are concerned, we should carefully distinguish, of course between the importation of foreign species and the encouragement of native ones which have been found useful to agriculture. As McAtee (1926) has recently shown, the local birds may be looked upon "as an ever-present force which automatically tends to check outbreaks, large or small, among the organisms available to them as food. It is a force which should be kept at maximum efficiency by protective measures and which should be taken into consideration and used whenever possible."

Bird protection then, both passive, by restriction of killing, and active by establishment of sanctuaries and perches, and checking of ground vermin, may be looked upon as a general insurance against insect outbreaks. It can rarely be considered as a measure against individual pests.

Save that in their case, protection is less practicable, the same remarks apply to insectivorous mammals, lizards and amphibians, the two latter being especially important in the tropics.

The control of weeds by means of their insect enemies is still entirely in the experimental stage. The best known attempt—that directed against *Lantana Camara* in the Hawaiian Islands, has been successful in that the plant has been largely prevented from seeding by insects introduced from Mexico. By this means its re-infestation of cleared land and its further spread are greatly checked. The prickly-pear (*Opuntia* spp.) in Australia—the most spectacular weed in the world—is also, according to latest reports, gradually succumbing to the attacks of insects and mites imported, on a very large scale, from America.

Numerous observers, in many parts of the world, have been greatly impressed with the tremendous mortality among certain insect pests, under certain conditions, through the attack of fungous parasites and bacterial diseases. And just as numerous attempts have been made to reproduce these conditions artificially, and to control outbreaks by propagating the disease. In particular instances, sweeping successes have been claimed, notably by Le Moult and by d'Herelle, but later observers have usually failed to obtain similar results. One of the most thorough and careful workers in this field, Paillot (1916) came to the conclusion that "la création d'épidémies artificielles comparables, en intensité et en étendue, aux épidémies naturelles, soit à peu près impossible dans l'état actuel de nos connaissances; trop de facteurs interviennent, en effet, dans la propagation de ces épidémies, qui échappent plus on moins complètement à l'influence de l'homme." Petch (1921) a mycologist who is perhaps the foremost authority on entomogenous fungi expressed the same conclusion even more strongly when he said,

"At the present day, after thirty years' trial, there is no instance of the successful control of any insect by means of fungous parasites. If entomogenous fungi already exist in a given area, practically no artificial method of increasing their efficacy is possible. If they are not present good may result from their introduction if local conditions are favourable to their growth; but, on the other hand, their absence would appear to indicate unfavourable conditions."

So far as insect pests are concerned—and these are the worst of our troubles, we are thus left with control by means of their insect enemies. But even here, further analysis is necessary before we arrive at what is practicable and promising and what is not. With insectivorous vertebrates we have just seen that importations have usually proved more or less disastrous mistakes while encouragement of local species is recommended as a measure of general insurance. Precisely the

opposite has been the case with insect enemies of insects, for here, as noticed above, all the most sweeping successes have been won with introduced parasites, while the attempted encouragement of native ones has usually proved futile. A consideration of these successes, and notably of those achieved in Hawaii, show that the most favourable circumstances may be summed up under four heads.

1. The pests to be controlled are immigrants, accidentally introduced without their natural enemies.

2. The indigenous fauna is of a limited and peculiar kind, so that the chances of the immigrants finding new enemies in it are very small.

3. The climate is warm and equable, allowing introduced parasites to multiply without seasonal checks.

4. There are only a few main crops, so that high organisation and centralisation are possible, and a small improvement is rendered important by the large scale of operations.

Probably no other part of the world is quite so favourably situated as Hawaii in reference to all four of these conditions. But it is safe to say that any country possessing these four qualities in some degree, is favourably situated for biological control. One would expect that once suitable natural enemies were discovered, imported and established, the task would in most such cases be accomplished. Probably the most unfavourable regions in which to attempt control of this nature lie in continental areas, with a rich and varied fauna, and a "temperate" climate, with a cold winter. In such areas it might be necessary to breed the parasites continuously in the laboratory and distribute them periodically, so as to force them into a condition of permanent dominance, to use the term of H. S. Smith. Such is the method used with the Australian ladybird, *Cryptolaemus montrouzieri*, in California, against the citrus mealy-bug. It is, of course, considerably more expensive than mere introduction and establishment accomplished once and for all, but at least in the citrus industry, it remains less costly than chemical measures of control.

This principle of assisting, as it were, the work of parasites already established, may theoretically be extended to indigenous natural enemies of pests either native or imported. In fact, the large scale utilisation of parasites already present, notably those of the codlin moth in California and of the sugar-cane borer (*Diatraea*) in Louisiana, is one of the latest developments of applied entomology. But such extension, whether on a large or on a small scale, has nowhere yet met with any striking success, and biological control as a whole should not be judged by the trial of it alone. The corollary is that the best results in biological control are to be expected in the future, as they have been obtained in the past, from the introduction and establishment of parasites from other regions.

When we come to the tropics it is often a matter of the greatest difficulty to decide whether a given pest is an introduced or an indigenous insect, and provided the entomologist ascertains exactly what parasites are attacking it in the various regions of its range, this becomes largely an academic question. The sugar-cane froghopper in Trinidad, evidently an indigenous insect, has very thoroughly adapted itself to cane-field, *i.e.*: essentially exotic conditions, while its local enemies have very largely failed to do so. The position thus simulates that of an insect introduced into a new country, without its natural enemies, and the way is open for the importation and establishment of foreign parasites which are as well adapted to cane-field conditions as the froghopper itself. The same principle applies to a number of other tropical pests.

A most essential part of the work consists in freeing the imported parasite from its own natural enemies (hyperparasites) before it is liberated. Mistakes of this kind are usually irrevocable.

The controversy as to the necessity for a sequence of parasites to attack various stages of the pest insect, with the dangerous tendency to the opposite extreme of super- and co-parasitism, or the injurious competition of several parasites for the same individual hosts, seems now to have been resolved in the policy of sending one or two judiciously selected species at the beginning, and observing their effect, before introducing others. The choice of species to introduce must, in the present state of our knowledge, be left in each case to the judgment of the specialised investigator who can study the pest and its enemies in the different parts of its range.

The emphasis on foreign parasites implies, of course, that the task is not one for the local entomologist to perform single-handed. Biological control offers an extremely promising field for co-operative research, and with the foundation by the Empire Marketing Board of a special laboratory for this work under the Imperial Bureau of Entomology, its rapid further development along these lines, throughout the Empire, seems assured. The mission of the present writer to the extremely promising field of the West Indies is the latest extension of the same organisation.

NIGERIAN COTTON.

It is stated in the *Seventh Annual Bulletin of the Agricultural Department*, Nigeria, 1928, that as a result of Mr. Engledow's visit a new scheme for organised seed distribution has been drawn up, the object of which is to maintain the quality of American cotton produced in the Northern Provinces, by supplying farmers with fresh seed from selected strains every three or four years. This scheme is to come into operation this season and the work of multiplying the selected strains will devolve on the Empire Cotton Growing Corporation's Seed Farm at Daudawa.

VITAMINS.

(*Concluded.*)

By Alfred Clark, F.R.C.S.,
Acting Government Pathologist, Trinidad.

IV.—Vitamin C.

Although the symptoms of a deficiency of vitamin C which characterize the disease called scurvy have been known for many years, their dependence upon a lack of one essential in diet was not recognised until the existence of vitamins was discovered, and our knowledge of the disease thereby clarified. Mankind had from the earliest times looked upon disease as due to some noxious substance or miasma or humour which had effected an entrance into the body and it required a reconsideration of all the accepted beliefs of medicine to recognise the origin of any state of ill health in subjects whose hunger was satisfied every day as being due to something lacking in the food supplied. To say that an animal, man or rat, could die of starvation with a full belly seemed the statement of one who was not wise.

Kramer, an Austrian army physician, in 1720 encountered a severe epidemic of scurvy. The following is an entry in his book :—" Scurvy is a terrible disease for which there is no known cure. Medicine does not help, neither does surgery. Be careful of bleeding : shun mercury as a poison. The gums may be massaged, the stiff joints may be rubbed with fat but all in vain. If one could only have available a supply of green vegetables or a sufficient amount of the vital antiscorbutic juices, or if one could have at hand oranges, limes or lemons . . . then one could be in a position to cure this dreadful disease without other help."

That the disease was not the result of cold weather, sea air, salt meat or some malign influence was stated by Bachstrom in 1734 (*observationes circa scorbutum, ejusque indolem, causas, signa et curam*) and he stated confidently that this ill of mankind was due to a want of fresh vegetables and fruits.

Vitamin C is widely distributed in the vegetable kingdom and where fresh fruit and fresh vegetables are a considerable part of the daily fare no anxiety need be felt as to its adequate supply. All green vegetables, especially crucifers, germinating seeds, and most fresh fruits contain it, but the richest source is the citrus group—lemon, orange and lime. So far as the tropical fruits are concerned their relative values have been carefully investigated by Jansen and Donath in the Dutch East Indies. They find that 10 g. a day of banana are needed to prevent scurvy in young guinea pigs: an amount which indicates a low vitamin C value but the large quantities of this fruit consumed in the tropics renders it a useful source.

They also examined certain varieties of lemons and limes for their vitamin C content as it seemed important to determine whether they belonged to the powerfully antiscorbutic lemon class or to the much less effective lime class. The *Citrus vulgaris* imported from Brazil and the sweet orange from Surinam contain very little C., 10 c.c. of the juice being the daily dose required to protect guinea pigs against scurvy. Similar figures were obtained for the *Citrus limonellus*, a species of lime grown in the East Indies for making 'squash'. On the other hand the *Citrus nobilis*, a sweet orange resembling the tangerine, and the *Citrus decumana*, are at least twice as rich as the two varieties first mentioned. Bottled lime juices were found to be less efficient than either of the classes of fresh fruit.

Of the nature and chemical constitution of vitamin C still less is known than of those already mentioned and comparatively little laboratory work has been done upon the subject.

One queer fact with regard to it has been established and that is that its stability varies greatly in different antiscorbutic foods, the tomato, which is rich in it, retains its high potency with little diminution when it has been subjected to drying, to cooking, or to canning, whilst Delf and Tozer found that cabbage heated for an hour at 60° C. lost 70 per cent. of its vitamin C, at 90° C. it lost 90 per cent. whilst 20 minutes heating at 100° C. only decreased it by 70 per cent. The lesson to be deduced by the cook is obvious. The addition of an alkali (sodium carbonate) to the water is said to increase the loss of the antiscorbutic but when boiling water is so effective in its destructive effect a little increased deterioration of the food seems a trifling matter. In the tropics at all events our supply of C can be secured by the consumption of fresh fruit. It has been suggested that the stability of the vitamin content of the tomato depends upon its being held in an acid combination and it has been proved that the stability of the vitamin C in cabbage is increased by the addition of an acid to the cooking water.

This vitamin is soluble in alcohol and also in water and the water in which vegetables have been boiled contains a considerable proportion of the undestroyed vitamin. Vegetable soups therefore, possess antiscorbutic values. I think I should prefer death from scurvy to dishonouring my stomach with such a food. As in the case of vitamin A oxygenation hastens its destruction.

In laboratory work on the vitamin C value of foods the guinea pig is used, for this animal is prone to scurvy and reacts very delicately to its absence just as the pigeon reacts specially to the absence of B by developing polyneuritis, and the rat to the absence of A by developing xerophthalmia. Every living creature has its place and its work in the scheme of nature's experiments—even Man who confirms for us our laboratory findings, notwithstanding the consequent injury to his own health.

It remains to detail briefly the signs of scurvy. Its onset is insidious. There are symptoms of weariness and lassitude, dizziness on standing up and bruising or bleeding from the gums on slight provocation. Pains in the legs are often complained of and there may be a characteristic hardening of the muscles of the calf. The eyes

are encircled by dark rings. In slight chronic cases these symptoms persist without much accentuation but with progressive weakness. If the deficiency is of a greater degree they are exaggerated continuously. Subcutaneous haemorrhages occur as well as bleeding into the joints, anaemia is profound and death may follow.

In the case of the guinea pig placed upon a diet free from C the animal grows normally for 15 to 20 days and then the first symptoms of scurvy are noticed. It loses weight and after 30 to 40 days it dies.

The symptoms are similar to those found in the same disease in man. The molar teeth become loose and the gums bleed: sometimes they ulcerate. Haemorrhages occur in the soft tissues of the joints and under the periosteum of the ribs. There is bleeding from the kidneys. Often there is great pain in the joints which occurs quite early. The animal assumes a characteristic position, lying on one side with the painful limb stretched out into the air, or an equally characteristic attitude with its head on the floor as though the poor little beggar had toothache. No doubt it has.

This vitamin resembles vitamin B in the fact that it is not stored in reserve in the animal's body but must be a daily ration.

Vitamin D.

Vitamin D like vitamin A is soluble in fats and is present in cod liver oil, green vegetables, butter and milk. It is the one vitamin of which we are able to say that its origin and nature are known.

The precursor substance of the vitamin is ergosterol, one member of a large class of alcohols (the sterols) which includes cholesterol as well as other sterols found in the animal body and phytosterols which are found in the vegetable kingdom. But vitamin D is not ergosterol. It is formed by the action of sunlight or other sources of ultra-violet light upon this substance but prolonged irradiation leads to destruction of the vitamin.

Rosenheim and Webster at the National Institute for Medical Research have very recently demonstrated that the other sterols do not develop vitamin D when irradiated. Ergosterol appears to be its only mother and ultra-violet light its father and they may well be proud of their child, for it has conquered the deforming devil we call rickets and deserves all the fame which it has earned.

Rickets is a disease of which the most prominent symptom is imperfect calcification of the growing bones of young animals. This leaves them soft and pliable so that many deformities of the skeleton occur. The bones of the skull are late in closing up the fontanelles. The teeth are delayed in appearing and are imperfectly formed and prone to decay. The ribs are deformed giving rise to pigeon breast and depression of the sternum.

The pelvic bones are pressed together giving rise to difficult labour. The bones of the legs are bent to bandy legs or knock knees.

The function of vitamin D in the animal economy is the control and promotion of the assimilation of calcium and phosphorus. The administration of these elements will not prevent or cure rickets in the absence of vitamin D. Nor will the administration of ergosterol in the absence of sunlight, natural or artificial. Nor will sunlight in the absence of any of the other factors needed for proper ossification of cartilage. Each is indispensable.

Besides this effect upon the development of bones and teeth vitamin D is concerned in maintaining the calcium content of the blood and if enormous quantities—a million times the amount needed for health—are administered the animal develops a condition of hypercalcaemia and dies. The action of an excess of carbohydrates in the diet is to inhibit the action of the vitamin so that dental decay and bony deformities arise. Mellanby has shown that certain cereals are more antagonistic to the vitamin than others and the worst according to his experiments is oatmeal. This means that the amount of the vitamin required on such cereal diets is greater and not that the cereals must be avoided. Abundant milk will overcome the harm that would ensue if the cereals were taken without this or without some other food containing the vitamin such as green vegetables or cod liver oil.

Vitamin E.

Vitamin E, the latest found of the vitamins at present known, is the food factor upon which animal fertility depends. It is fat-soluble and often associated with A. No serious attempt to isolate it has, so far as I know, been made, but its existence and its importance as an essential factor in reproduction is proved. It exists in many green vegetables, and lettuce appears to be amongst the richest sources in that class of food. Infusion of tea-leaves contain a little E. Butter and milk are good sources. The germ of cereals is still richer in the substance and it has been plausibly suggested that the sterility which seems to appear in those nations which have adopted great luxury in their mode of living owe their declining birthrate at least as much to the over refinement of their food as to voluntary birth control.

The mode in which sterility is produced by this deficiency is strange but simple. The fertilized ovum undergoes the normal process of implantation on the uterine wall but after a few days growth ceases and the whole embryo disappears by resorption. An interesting point is that the presence of lard in the diet, even when sound, tends to counteract the antisterilizing property of the vitamin. The addition of 10 per cent. of lard to a diet was sufficient to change a high fertility rate (83 per cent.) to a high sterility (92 per cent.). When the lard or any other fat is rancid it neutralizes the fertility vitamin even in wheat germ. This effect seems to be due to the presence of oleic acid and not to stearic acid.

Summary.

In the preceding articles a synopsis of the present state of knowledge as to the nature of vitamins has been given and a description of the consequences which follow their absence from the daily fare or their presence in only inadequate amount. It remains to supply some indications of the way in which modern knowledge of food values, incomplete though it be, is applicable to the every-day problems of life in the tropics.

The first matter to be considered is the selection of foods. Apart from their vitamin value these consist of three principal classes—the carbohydrates, the fats and the proteins. The carbohydrates are to the human engine what petrol is to the motor engine. The fats are to the body we inhabit what the fireplace is to our houses. The proteins are to our machinery what the materials for maintenance of the working parts are to the engine. In this analogy it would be fair to liken the rôle of the vitamins to that of the electric spark. In the class of carbohydrate foods (those containing starches and sugars in large quantity) are flour, meal, rice, sago, tapioca, potato, tannia, yam, cush-cush, cassava, eddoes, sugar, treacle, syrup and so on. A healthy man who works hard may need as much as 18 ounces of carbohydrate daily, but the amount needed varies according to the metabolic processes of the individual, and considerably less may suffice to maintain health and energy. This amount, however, is often grossly exceeded and obesity and disinclination for manual work or exercise results. Besides this consequence the unnecessarily large amount of carbohydrates leads to fermentative changes whilst it lies in the digestive organs, and flatulence and acid dyspepsia follow.

In the case of the consumption of large quantities of sugar there is the additional penalty of a catarrhal condition of the mucous membrane of the stomach and bowels which occurs constantly. In rats so fed the catarrhal secretion forms a coating over the membrane which can be removed after death as a skin-like cast of the organs. In human beings the consequences following the consumption of sugary foods such as sweets, chocolates, cakes and biscuits between meals are extremely bad, and our grandmothers' idea that sweets ruin the teeth is quite true. The glutton always has to pay, and the vicarious gluttony of the indolently indulgent parent towards the child has to be paid for thrice over—by the father in doctors' and dentists' bills, by the mother in anxiety and by the child in pain and unhappiness.

Fats are needed in greater or less quantity according to the climate in which we live. They are heat-producers chiefly, but also contain cholesterol which is necessary to life. In arctic climates very large quantities are required, but in the tropics two ounces a day will suffice and this amount should not be much exceeded. It may be taken in the form of meat-fat, butter, cream or vegetable oils. It must be remembered that vegetable oils contain little of the fat-soluble vitamins, and these must be provided in green vegetables, liver oil, butter or milk if rickets are to be avoided.

Proteins are contained in small quantity in most vegetable foods, but proteins obtained from this source are wanting in certain amino-acids which are essential for health. This is especially the case with maize (Indian corn), and the use of corn meal as a staple food is unwise. Animal protein to the amount of two or three ounces should be eaten daily. This need may be satisfied by the consumption of cheese, meat, fish, fowl, milk or eggs.

The method of cooking is important. Tubers should not be used for the making of soups or stews unless they have first been boiled for at least half an hour separately from the other ingredients of the dish and the water in which they are boiled and which contains a poisonous principle, thrown away. Green vegetables—cabbage, spinach, lettuce, green peas and beans, carrots, ochroes, &c.—should not be boiled longer than a quarter of an hour and only with the use of the least possible quantity of water. This water may be used as a stock for soup, because it is rich in mineral salts and has some vitamin value.

Raw foods such as lettuce, watercress, tomatoes and fruits are needed as a daily food and may be eaten in the natural state or as salads. Meat, poultry, fish and eggs may be cooked according to taste, but twice-cooked food is better in the dustbin.

In the case of fish, flesh and fowl it should be kept in mind that the fats contain vitamin A, the liver vitamins A, B and D, the brains and sweetbread A and B.

In preparing green vegetables the darker coloured green leaves should not be thrown away as they are rich in vitamins A, C and D. Soda should not be used in cooking.

In the making of bread, pastry and cakes whole-meal flour should be employed in preference to white flour. The taste for food made with white flour is an acquired one and this foodstuff is so insipid that when once the natural preference for the whole-meal has been regained there is no return to the white. As an illustration, I may relate the experience of a sheep-station holder in New Zealand. This station is situated in a remote and unroaded part of the coastal hill country and the difficulties attending the transport of supplies were great, as the only means of approach for wheel traffic lay for many miles along a stony river bed which was only practicable at certain seasons of the year. Of course the wool clips had to be sent to the nearest town for sale, and when the lorries returned they brought up the provisions for the period that must elapse before the station produce was again sent down. Amongst the food ordered every time was a large number of bags of white flour, and on one occasion

a single bag of whole-meal flour was ordered in addition, for the use of the station holder's family.

When the lorries had completed their arduous double journey and the provisions were unloaded, it was found that by mistake the bulk of the consignment of flour was whole-meal and the white flour consisted of one bagful. There was consternation, almost dismay, amongst the station hands when the discovery was made. They swore that they could not be expected to eat that pig-food every day for months, but the error could not be put right. They grumbled, but hunger is the best of sauces and they ate.

Months passed by; the grumbling had died down and again the wool lorries were to leave on their journey. The men asked the station holder to have only whole-meal flour fetched from town as they had grown accustomed to it and preferred it to the white.

It is worth notice that the addition of bran to porridge or its use in biscuits, cakes or scones is an almost infallible cure for constipation, as it contains indispensable 'roughage' as well as vitamin B.

To sum up the dietetic errors of tropical countries, I should say that the greatest harm results from the excessive consumption of white flour, polished rice, tubers and sugar; the insufficient use of food materials containing vitamins, especially vitamin B and in the case of infants and young children, vitamin D. The West Indian diet of polished rice, salt fish, white flour, sugar, oil and lard is certainly unsuited to this or any other climate on the round world. The East Indian diet in which the carbohydrate excess of the rice is to some extent balanced by the addition of dholl, a food rich in protein and vitamin B, is better but not quite satisfactory. By modifying either of these dietaries in accordance with the knowledge we possess, a suitable daily ration could be easily obtained without coming into very serious conflict with racial preferences.

One other point remains to be noticed. That is that the food is usually served in a sloppy condition which affords no work for the teeth. The luscious tropical fruits too do not compel proper mastication as an English apple does. This may be corrected, and should be corrected, by eating with each meal some hard food such as hard, dry, toasted brown bread, rye biscuits, nuts or such other hard foods as may be obtainable.

* * *

The price to be paid for neglecting to rectify these errors is being paid every day in sickness, deformity, pauperism, crime and unhappiness, and this heavy due will be exacted quite inexorably by Nature until we mend our ways.

It is well to remember that the ill-fed man is a lazy man and an inefficient man and a standing menace to the prosperity of the country he lives in. I have a firm conviction too, that this ill-fed man tends to drift into the rum-shop to relieve the lethargy and digestive discomforts which results from dietetic errors.

KAPOK.

MR. A. A. RITCHIE, Entomologist to the Tanganyika Department of Agriculture writes that, owing to the general relationship of cotton and kapok, the Department is making enquiries as to whether kapok can be grown in the Territory without deleterious effect on the quality of the cotton. The problem centres itself round the inter-relation of the two crops, with the red stainer which subsists and multiplies on the bolls of both. Investigation has shown that this insect by means of its puncturing snout may mechanically transmit the fungus organism which causes the yellow staining of cotton lint or may cause those puncturings of the cotton boll wall through which the stain fungus is assisted to gain entrance to the lint. The Department recognised that it must decide whether to countenance or prohibit kapok growing as this crop might, from the experience of other countries, aggravate an already serious cotton problem—stain. On investigation of the problem in the Territory, the facts are against any such likelihood.

In Tanganyika, the problem is simplified by the fact that the kapok cropping season is December to February, when, in the major cotton districts, cotton plants have already been or are about to be uprooted. Any increase of red stainer consequent upon the falling of kapok is then unable to have any soiling effect on cotton lint, the crop having already been made. If, however, the kapok crop coincided with or slightly preceded the cotton crop, the decision would be against kapok as, in the event of both crops being grown, red stainer would assert itself in such numbers as to render the production of clean cotton lint almost an impossibility.

The growing of kapok is, therefore, considered as practicable without interfering with cotton interests, but as a safeguard it is proposed to regulate the conduct of kapok plantations by cleaning up crop residues in the plantations (as with cotton) and by planting and maintaining plantations in such manner as to readily permit of such sanitation and inspection. Kapok plantations cannot in this wise serve by means of their fallen crop residues as breeding grounds for stainers for the cotton crop.

Kapok grows extremely well in the Morogoro District and a very considerable extension of kapok planting is now anticipated. In plantations established during the German regime the trees are set six metres apart. This permits of 278 trees to the hectare. Well established kapok is yielding from 2 to 5 kgms. of merchantable floss per tree. 1928 floss fetched from Shs. 1/30 to 1/40 per kgm. delivered at railway stations in the Morogoro District. There was also a market for kapok seed, the price paid being Shs. 80 per ton, Dar es Salaam. Kapok seed contains 20 per cent. oil which is used in soap making and as an adulterant of other oils.

It may be mentioned here that the relation as to cotton stain of bacbabs which crop ahead of cotton and which afford a feeding and breeding ground for red stainer is also receiving the Department's attention.

CARBOHYDRATES IN PLANTS.

Very little is certain as to the movements of carbohydrates in the plant. It is generally agreed that the green plant can build them up for its own needs in leaves exposed to the light, and that these supplies are then utilised in growth throughout the plant, so that considerable movements of sugars must take place from the leaves to the roots, and fruits and various storage organs. There is no agreement, however, as to the tissue through which this movement takes place. Only two tissues, regularly present in this plant axis, are so extended in the longitudinal direction as to be very likely to convey such substances for long distances through the axis; these are the wood or xylem, and the phloem or bast. Usually, the sieve-tubes of the phloem have been regarded as the channels of sugar transport, as micro-chemical observations, such as those of Prof. Mangham, seemed to show considerable quantities of sugar in these tissues. The phloem in many trees is confined to a narrow layer near the periphery, so that it is possible to cut this channel completely by removing a narrow strip of tissue from the outside of the stem, and there is evidence that such ringing experiments always interfere with carbohydrate transport. Prof. H. H. Dixon pointed out, however (*Nature*, Vol. CX, 547-551, 1922), that the xylem sap usually contains appreciable quantities of sugar, and that in the ringing experiment it is very difficult to remove the phloem without doing some damage to the wood. As a result, the wood may be partially blocked, so that the interruption of the carbohydrate movement, attributed to the ringing of the phloem, may be really due to the partial choking of the xylem channels.

In much of the experimental work done to elucidate this problem, the transfer of carbohydrates through the region of the axis experimented upon is gauged by the amount of growth afterwards made as the result of supplies assumed to come from sources on the other side of the ring. Thus Prof. Otis F. Curtis has published a series of observations upon ringed shoots which were defoliated above the ring, and as a result made little growth, presumably through the failure of supplies to cross the ring. In such experiments the plants have obviously to be left for some time following the original ringing operation, and though Prof. Curtis has on many occasions followed up his observation of growth by quantitative analyses of his plants for carbohydrates, nitrogen, &c., it is difficult to know how much the re-distribution observed has been determined by metabolic activities connected with growth, and how much it has been directly the result of the interruption of translocation in the phloem. None the less, the work of Prof. Curtis has established a very strong presumption that the phloem is at least very active in the transfer of carbohydrates and probably many other substances through the axis of the plant. In two recent papers by Messrs. Mason and Maskell in the *Annals of Botany* (Vol. XLII, January, 1928, and July, 1928), a great deal of new evidence is supplied which points in the same direction. The Empire Cotton Growing Corporation has recently issued a reprint of these papers(1), which form an outstanding contribution, based upon an intensive study of the cotton plant, to the solution of the general problem of the transport of carbohydrates in the higher plant. The papers occupy together more than 120 pages, and they describe much suggestive experimental work, with critical discussion of procedure and results, for which reference must be made to the original papers.

The experimental method adopted by Messrs. Mason and Maskell has been to follow, by analytical methods that permitted of certain standard determinations on numerous samples in a limited time, the changes in carbohydrate content in isolated samples of leaf, wood, and bark (the latter tissue including the phloem) within periods of time usually not greater than two or three hours. Sucrose, reducing sugars, and reserve carbohydrates were estimated separately, and the results expressed on the basis of the residual dry weight (total dry weight less carbohydrates) as a quantity that is less liable to fluctuation than either fresh weight or dry weight. Unfortunately, at each sampling an experimental plant is sacrificed so that large numbers of plants of one strain of Sea Island cotton were grown under as uniform cultural conditions as possible, several samples taken and analysed separately on each occasion, and statistical methods applied to the whole series of results obtained in any one experiment, so that significant correlations and differences might be determined. In these experiments, therefore, any movements of carbohydrates that may be indicated will be the direct result of a fairly rapid longitudinal movement of these substances through the tissues, and not the indirect result of growth activities, which are not likely to produce very appreciable changes in such short time periods.

The immediate results of the new experimental method was to establish a significant correlation between the diurnal variation in the concentration of sugars in the leaf with similar variations in the bark, but not usually in the wood. At a distance some 50 cm. or more below the leaf, the variation of concentrations in the bark seems to follow the same curve, but is two or three hours later in reaching similar points on the curve. Reserve carbohydrates, which fluctuate greatly in the leaf, show little or no change in wood or bark, and are not considered further in the present brief discussion. In experiments in March, fruit bolls were included, and samples of wood and bark lying between leaf and boll. The result was

(1) "*Memoirs of the Cotton Research Station, Trinidad*, Series B, Physiology, No. 1. *Studies on the Transport of Carbohydrates in the Cotton Plant.*" By T. G. Mason and E. J. Maskell. Empire Cotton Growing Corporation, 2, Wood Street, Millbank, London, S.W.1, 1928.

to show significant correlations with similar time lag in the sugar content of leaf and bark and the dry weight increase in the developing fruit.

In September and later months, the results of ringing experiments were examined by the same methods at six-hourly intervals after the ring was made, with the result that above such a ring, made below the leafy region of the plant, an accumulation of sugars was soon observed in both wood and bark, whilst in the 6½ inches of wood and bark just below the ring there is a marked fall in total carbohydrates. In this case correlated changes were noted in both wood and bark, and these and other experiments suggest to the investigators that an accumulation of sugars in the bark at any region is followed by a slow radial transfer of sugar into the wood in this region. Other ringing experiments, however, in which flaps of bark were lifted off the wood and separated from it during experiment by paraffined paper or vaseline, showed that, provided these strips of isolated bark remained connected to the foliar region above by continuous channels in the bark, accumulation of sugar still took place in them, though they ceased in the wood in the same region.

These experiments, on the whole, seem to provide very definite evidence that the major movement of carbohydrates from the synthetic centres of the leaves takes place through the phloem, though the possibility of carbohydrate movement under certain conditions in the xylem is, of course, not excluded. Experiments in the second paper, in which different regions of the phloem are analysed separately, suggest that the inner region which consists more predominantly of sieve-tubes, and possibly to a large extent of developing ones, is the region in which most of the longitudinal movement takes place, because the concentration of sucrose is much higher in the inner region, so that the concentration gradient of sucrose outwards in a radial direction is 300-500 times as steep as in a longitudinal direction.

Whilst Mason and Maskell have thus supplied striking experimental evidence in favour of movement of sugars through the phloem, they do not fail to point out the difficulties in the way of understanding this phenomenon. Changes of sugar concentration in the leaf sap are followed by changes in the phloem of the axis, as if the concentration gradient determined the movement of sugar, as it would do in the case of movement by diffusion. But from the rapidity with which these concentration changes are registered at distances of more than 50 cm., they calculate that the longitudinal movement of the sugar in the sieve-tube is at least 20,000 times too fast to be due to diffusion of sugar through an aqueous medium. Furthermore, there is another stumbling-block in the way of regarding the concentration gradient as the driving force determining movement. In the leaf the variation is principally in reducing sugars, and this is followed by changes in the concentration of sucrose in the phloem. They conclude, therefore, that sugar moves in the sieve-tubes by a process analogous to diffusion, but that the mechanism by which such high absolute rates of movement are maintained is unknown.

In this connection the possibilities of streaming movements in the segments of the sieve-tube might be worthy of further examination. It is a well-known fact that in many elongated living cells the protoplasm of the cell rotates within its wall at speeds which would permit of movement along the cell at rates of several centimetres an hour. There is still the need of transfer from one rotating protoplast to the next on the opposite side of a cellulose wall, but the distance thus traversed by diffusion will not be more than $\frac{1}{100}$, the total distance travelled in the sieve-tube. This method of transfer would then result in movement, which would obey the concentration gradient, and yet be very much more rapid than diffusion in water. Mason and Maskell apparently reject it because protoplasmic rotation is rarely seen in the adult sieve-tube—although it has been reported by Lecomte. On the other hand, in sections of young developing phloem, as in tangential longitudinal sections through the inner bark of trees, which are mounted in water, most lively streaming movements are usually visible. Strasburger has also shown how readily similar movement can be seen in long cells in the phloem of herbaceous plants which were very possibly developing sieve-tubes.

Whilst the adult sieve-tube, therefore, may act as a reservoir, which is gradually depleted by local utilisation of its contents, the streaming segment of the developing tube may be responsible for the rapid longitudinal transfer of the carbohydrates. Mason and Maskell eliminated, so far as possible, the complications introduced by growth activities by cutting down the duration of their successive experiments so far as possible. But the inner segment of the phloem in which the very high concentration of sucrose was observed would contain all the young sieve-tubes developing from the cambium.

This consideration might throw some light upon a gradient of reducing sugars in the leaf being followed by an equivalent gradient of sucrose in the phloem of the axis. Any enzyme synthesis of sucrose from glucose and fructose *in vitro* has so far proved impossible, and in the light of modern knowledge of the difficulties of sucrose synthesis (*Nature*, 13th Oct., 1928, p. 578), this is quite explicable. In the sieve-tube it is difficult to see how the direct conversion of reducing sugar to sucrose is to be brought about, but if the reducing sugars are employed in the construction of living protoplasm, which is then utilised in the construction of a new series of sieve-tubes from the cambium, in the differentiating sieve-tube sucrose may be found instead of the hexoses which originally entered into the composition of the protoplasm.—(Review by J. H. Priestley reprinted from "*Nature*," No. 3091, Vol. 123.)

THE DATE PALM.

(*We publish below two notes received from Mr. H. V. W. Dowson,* M.A. (Cantab.), *on the date palm's origin and of its cultivation in the Shatt ul Arab, Iraq.*)

I. The Date Palm's Origin.

The origin of the date palm, like that of most cultivated crops, is lost in antiquity. The world's earliest known monument to which a definite date can be assigned, namely the temple of the Moon god recently excavated near Ur, used the date palm in its construction. That it grew between six and seven thousand years ago is thus certain, and that it was cultivated at that early period may be conjectured from the fact that the excavations reveal that those who built this building were artistically a highly developed people. It is not probable that agriculture in general, and the culture of the date palm in particular, would have been neglected by them. Bas-reliefs of the fertilization of the date palm, dating from nearly four thousand years ago, and now to be seen in the British Museum, prove that, whatever the former case, it was cultivated at this time. And they prove more than that, for the reliefs show the fertilization of the date palm a religious ceremony. Religious ceremonies do not introduce agricultural practices, but they sanction, or sanctify long established customs; so that there is very little doubt that artificial fertilization of the date palm is of far greater antiquity than the relief referred to, and, also it may be presumed, the whole culture of the palm.

The first writers of travel books on the countries lying between the Atlantic and Persia, whose observations are preserved to us, mention the culture of the palm. The palm is the symbol for a year in Egyptian heiroglyphics, and a frond for a month, pointing to a high antiquity for the crop, for a people does not choose that which is not well known for a common sign in its most primitive writing; and the earliest writing of the Egyptians was certainly in use before the erection of the temple of the Moon god at Ur. The theory of Mr. Willis and Mr. Udny Yule that the age of a genus may be estimated by a consideration of the number of species comprising it in conjunction with its distribution lends support to the belief that the date palm, as we now know it, is of very high antiquity, in that, though there are not more than a dozen species of *Phoenix*, yet their distribution embraces an extended belt of the earth.

The present distribution of date palms, unlike that of most cultivated crops, differs little from that of the date palm as we know it in earliest historical times. Wheat, maize, tea, rubber, apples, plums, oranges, vines, turnips, and potatoes cover vast areas formerly without them. But the increase in the area under the date palm is insignificant. Parts of the Punjab, small parts of Southern California, of Arizona, of Texas, and of Mexico, Hergott Springs in Australia, small areas in Damaraland and Namarqualand, Elche in Spain, Bordighera in Italy, these are all the new areas. Of them, the one of greatest importance is that in the United States where there are to-day a million palms, and where one-twentieth of the United States' consumption of dates is produced.

It is necessary to explain why the date palm should still be confined almost to the countries in which we know it from remotest recorded times, because crops are rare which, like it, produce annually per acre, with but comparatively little attention four or five tons of fruit, which is not chiefly water, like most, but largely a much more valuable product, sugar. The reason is that, from the flower to the ripe date, six months must elapse, during which time, great heat is needed. Low temperatures during the night spoils the fruit, and so does rain. Great loss has been incurred in many places in America, where date offshoots have been planted in land thought to be hot enough. When the palms began to bear, it was found that cold air coming down the mountains at night, or early rains prevented the dates from ripening properly. To some extent, this difficulty has been overcome by the adoption of artificial ripening practices. But the broad generalization remains that dates will not grow except in the desert belt 30 degrees North and South of the equator.

II. Date Culture on the Shatt ul Arab.

It is difficult to account for the reputation which the Iraq holds as possessing soil of exceptional fertility, seeing that most of the crops grown are grown better in other countries, but there is one crop, however, for which the Iraq is pre-eminent; and that is dates. The quality of the dates grown here is good; the method of the cultivation is good; and the quantity produced is greater than that produced in any other country.

Date palms are found growing in the open in at least forty-three different countries; but the date industry is of importance only in the following as is shown from the approximate figures given below:—

Country.	*No. of date palm trees in Millions.*
(1) Iraq	13
(2) Arabia	8
Algeria	8
Egypt	6
Tunisia	2¼
Morocco	2
Persia	2
Sudan	1¼
Other Countries	3½
Approximate World Total	46

(1) Of Iraq's production about seven million line the Shatt-ul-Arab and the banks of the Euphrates below Madinah.

(2) The calculation of the number of palms in Arabia is a matter of difficulty, since information concerning the industry there is scanty, unreliable, and scattered.

From these figures it will be seen that Iraq grows nearly one quarter of the world's date palms and although it is quite true that no other country contains so many date palms as the Iraq; yet, as other countries do grow date palms, there remains always the possibility that their production might rival that of the Iraq. At present, however, she has no competitor, in the great markets of the world, in the bulk trade, though the fine date export trade is almost entirely in the hands of the Algerian and Tunisian growers.

The following figures show the annual exports by sea from the countries named :—

The Iraq	....	....	110,000	tons.
Algeria	....	....	10,000	do.
Tunisia	....	....	1,000	do.

The total American production (there are no exports) is under 500 tons. The value of the dates exported from the Iraq is from one-third to one-half the value of the total exports.

Enough has been said to show the important place occupied by the Iraq amongst date producing countries and to show the important place the date palm takes in its agriculture. The question of interest, which next follows, is that of the profits of date culture in this country.

It may be said at once that an acre of bearing date palms yields a more valuable harvest than any other crop grown in the country. The best gardens on the Shatt ul Arab growing the most valuable commercial kind of date, the Hallawi, which is sold at about 500 rupees a *karah* of 6,040 lb., may produce a gross annual return of nearly 1,000 rupees a *jarib*.* Most gardens, however, would produce only half that; because comparatively few are planted only with choice varieties, and because such a high return is obtainable only from exceptionally well tilled land. The expenses of cultivating and harvesting are generally conceded to amount to approximately half the gross return. Thus, the net return from a moderately good, Basrah, date garden is probably in the neighbourhood of 250 rupees an acre. However, the area of badly kept, and insufficiently watered gardens is large; and from these there would be obtained only a much smaller income. The possession of ten *jarib* of date bearing land is commonly considered to relieve a man of the necessity of working. The net return per acre from date land is thus comparable with that from the best orchard or market garden land in temperate climates, and is certainly ten times that from field crop land in the Iraq, with the exception of the better rice districts. These figures are based on the yields of gardens of fully bearing palms. As a palm does not come into full bearing, until about 15 years after it is planted, for some years the garden must be run at a loss, since it needs cultivating and watering all the time. Consequently, the cultivation of dates is essentially a matter for capitalists; though, owing to this lapse of time between incurring the expenditure and the receipt of revenue, it is a matter for doubt whether there is much profit in it. If virgin soil be planted with date palms, a total sum of about 3,000 rupees an acre would have to be spent, before, in about ten years, it began to pay for itself; but paying off the capital together with the compound interest thereon would take all the profits for several years more. There is a special circumstance at Basrah, which gives the date gardens there a fictitious value, namely the custom of the inhabitants to invest their money only in land. Since the area of freehold land is comparatively small, and since it is obviously not advisable to sink money in land tenable on short lease, and since long leases are unknown here, the price of freehold land is high, and out of proportion with the profits realisable therefrom. Date land has been known to change hands in several cases at over 10,000 rupees an acre. A usual price now-a-days, for a garden producing 250 rupees net annually would be 5,000 rupees. That is to say, a return of five per cent. on money wisely invested can be reckoned in the purchase of bearing date land. On an investment in empty land and in its development as a date garden, the return would work out, on a long period, at about the same amount. The initial capital required is less; but there is a long delay before there is a return. To make this clearer, a concrete example may serve. Suppose two men each have 5,000 rupees capital. If A buy with his an acre of bearing land, and, at the end of the first year, with the profits, namely 250 rupees, buy a twentieth of an acre of bearing land adjacent to his garden, then, at the end of the second year, with the combined profits, namely 262 rupees, buy a second small piece of bearing land, and so forth, then, at the end of 30 years, he would have four acres of bearing land. If B buy four acres of desert land with his capital, and plant it up with offshoots and cultivate it, he would find, that before the end of ten years, when the expenses and expenditure should balance, that he has had to borrow another 7,000 rupees. For the next 20 years, he would be paying back this sum together with the compound interest accruing. At about the thirtieth year, he and his neighbour, A, would both be in about the same positions, clear of debt, and with about four acres of bearing date land.

Other crops may be grown with palms to make the groves more profitable; but, considering dates alone, the largest profits are made by the culture of the best varieties. In date growing, as in most other similar activities, the grower of a good quality product is generally assured of a good price, while he who produces the inferior or mediocre sort can hope to make money only in years of shortage.

* Acre equal 1·04 *jarib*.

Regulations have been made in the French Cameroon to prevent the import, export, or circulation of coffee plants or seeds that exhibit any trace of disease. This, of course, does not apply to coffee beans for consumption.—(*West Africa*.)

CACAO NOTE.

The Hybrid Nature of Forastero.

AN article which appeared in the *Tropical Agriculturist* of Volume 71, No. 6, emphasises again the extremely mixed nature of the constitution of cacao as ordinarily grown.

This is an account of the types of fruit borne by 609 trees on the Experiment Station, Peradeniya, which are known to be the progeny of a single Forastero parent tree. It has been compiled from notes made by the late H. L. van Buuren, Assistant to the Economic Botanist of the Ceylon Department of Agriculture, with a note added by F. A. Stockdale.

The parent tree is described as a form of Forastero Cundeamor, which was known to yield heavily, a yield of 172 ripe pods being noted in one season.

The progeny were classified according to the form and surface of their fruits and the colour of the cotyledons into 13 type-forms, which are illustrated by photographs, and the classification is summarised as follows :—

Angoletas			
	Criollo ..	.. 32	
	Nicaragua Criollo	.. 25	
	Smooth Angoleta	.. 101	
	Porcelaine Angoleta	.. 36	
Cundeamors		——	194
	Parent type ..	.. 144	
	Small ..	.. 15	
	Green ..	.. 34	
	Trinidad Criollo	.. 12	
	Smooth ..	.. 152	
Amelandos		——	357
	Calabacillo ..	.. 20	
	Trinidad ..	.. 18	
	Porcelaine ..	.. 14	
	Cacao Nacional	.. 6	58
	Total	..	609

When to this diversity is added the fact that slighter variation occurs within each of the types, the conclusion is reached that :—" Nearly every tree can be described as a 'form,' the pods of which approximate in characters to one 'form' that may be classed as typical of the tree. Another tree may show in its type only a trifling variation from the first tree, *e.g.* : a long tapering point or a moderately warty coat, but this is shown over and over again in the pods of this tree which can in turn be said to differ very minutely from the 'type' of another tree."

This paper may be said to demonstrate very clearly, first, the very little significance that can be attached to varietal names in cacao, when everything from "Criollo" to "Calabacillo" may come out of a single Forastero, and secondly the great importance of vegetative propagation as the only likely means of obtaining uniformity in the crop, whether for commercial purposes or for the sake of precise physiological research.

It is also of interest in its bearing on the theory put forward by Pittier (*Revue de Botanique Appliquee*, 1925) as a result of studies of the Venezuelan crop, that "Criollo" and "Calabacillo" were originally distinct species, and that all the types grouped as "Forastero" are to be regarded as hybrids between these two, which can be arranged in a regular series of transitional forms.

E. E. C.

CROPS PRODUCTS MANUFACTURE.

The following notes are taken from a series of articles published in the "Industrial Chemist," Vol. V.

Rubber.

The progress of the rubber industry has been complicated by the interference of political factors. The removal of the Stevenson scheme has caused considerable fluctuations in price which have correspondingly influenced the plantations. On the whole, however, the industry appears to be in a steady condition. The consumption of rubber in America during the third quarter of the year is said to be a record.

As a result of the necessity to reduce production costs, more attention is being directed towards the plantation rather than to the factory. The value of planting new areas with buds taken from carefully selected, high yielding trees is being appreciated and the yield of rubber per acre is thereby increasing. Efforts to breed high yielding strains are being rewarded.

Modern views on the structure and composition of latex have been summarised by F. A. Hauser in a series of published lectures. A more thorough understanding of its properties has enabled patents concerning the direct use of latex to be published. Electro-deposition of rubber continues to attract interest although little progress has been made towards an ideal treatment.

Attempts to improve the resistance to abrasion of rubber intended for such articles as motor tyres has resulted in a comprehensive study of the physical properties of carbon blacks of various types. The relation of these properties to the effects on the properties of the rubber with which they are incorporated has provided a wide field for research. The reports concerning the use of selenium for increasing the resistance to abrasions are conflicting and there is no united evidence that this element has any great advantage over sulphur. The influence of the physical condition of sulphur and its allotropic forms on the properties of rubber is being investigated.

Little has been added to the theories of the structure of rubber during the past year. The conflict between the purely chemical explanation of the structure and the colloidal explanation persists. There appears to be a tendency to merge the two ideas to form one satisfactory theory.

Apparatus and methods for giving rapid physical tests to rubber representing conditions under which it will be used, have been improved and made more reliable. The result of several months hard wear on a motor tyre can now be determined in a few hours. An investigation of the effect of temperature and humidity on the physical properties of rubber has revealed the fact that the humidity of the atmosphere in which the rubber is stored before vulcanisation, determines the physical properties of the final product to a large extent.

A survey such as this would be incomplete without reference to both reclaimed rubber and synthetic rubber. Methods of reclaiming rubber and particularly of compounding reclaim with raw rubber have progressed considerably. The use of reclaim is increasing rapidly and in the United States represents over one-half of the total consumption of rubber. In spite of numerous patents, there seems little progress towards the economic production of a synthetic rubber with suitable physical properties to compete with raw rubber. The advent of cheap butanol as raw material may place synthetic rubber on the market.

Oils, Fats and Soaps.

There was little change during 1928 in British imports and exports of oils and fats and their derivatives. The only significant change was in the increased importation of oil seeds. The increase was due almost entirely to the importation of soya beans. The use of palm kernels is decreasing, the supplies being diverted to Germany.

The demand for British toilet and bar soaps has increased. The chief progress in the soap industry, with which the production of oils and fats is so closely linked, is in the production of soaps with high detergent action for use with delicate fabrics. Patent soaps, obtained from highly sulphonated oils, which will lather in acid solution and which are particularly valuable in dye baths have been placed on the market. Fat refining processes and saponification under pressure have made small progress.

The increasing use of synthetic ethylene glycol as a substitute for glycerine is causing much anxiety among soap manufacturers. Ethylene glycol may be used for practically all purposes for which glycerine is used and in some cases is more suitable. A drop in price below that of glycerine would deprive the soap manufacturers of an important source of income. Nevertheless, glycerine is essentially a by-product and can be produced for the cost of its separation from soap-lyes. There is still a large demand for glycerine which has many more uses than is popularly supposed. Research is being made to increase still further these uses and thus stabilise the price. A further and perhaps more serious rival to soap-lye glycerine is 'fermentation' glycerine, produced during the fermentation of molasses. The distillation difficulties have been overcome and glycerine appears as a by-product of the power alcohol industry. Here the cost of the raw material is negligible. If the demand for alcohol were increased, fermentation glycerine might become a formidable competitor of soap-lye glycerine.

The introduction of vitamins A and D into margarine is an important advancement in the manufacture of 'synthetic' foods. High class margarine has now a composition and food value equal to that of good butter. A subsequent increase in margarine consumption may be expected.

Research on fats has been confined largely to the analysis of the raw materials into their component glycerides. A new method of investigation, consisting of oxidising the mixed glycerides in acetone solution with potassium permanganate, has led to a more detailed knowledge of the composition of natural fats. In a short time, no doubt, the results of those investigations will be reflected in industrial processes and production.

H. H. C.

TEA ROOT INFECTION.

As a result of a visit to Nyasaland in February and March, 1927, Dr. E. J. Butler has written a "Report on some Diseases of Tea and Tobacco in Nyasaland" (issued by the Department of Agriculture, Nyasaland, Zomba, July, 1928), which gives a general account of the diseases of these crops met with on his tour, which should be of considerable interest to all growers of tea and tobacco. An interesting feature in the report on tea diseases is the proportionately large space that has to be devoted to infectious diseases that appear to spread *via* the root system. *Armillaria mellea* is of course one of the most striking of these parasites, and a very clear account is given of the appearance of trees which have fallen victims to this pest. But stumps also appear to be rotted by *Ustulina zonata*, which has elsewhere proved a parasite to rubber (*Hevea*), whilst an internal root-rot *Botryodiplodia theobromoe*, when present, seems to be an even more deadly foe than either of these other parasites in the light of the planters' observations. Dr. Butler discusses the symptoms and manner of spread of an obscure root disease, often attributed to this last fungus, but concludes that the identity of the pathogen in this case must remain an open question for the present. Root diseases are probably all the more prevalent from two cultural practices. When ground is cleared, removal of the plant cover causes rapid washing out and impoverishment of the soil. As a result, root growth is poor and the root system more susceptible. Then on the other hand, tree stumps are not cleared out after felling, and, from his wide experience, Dr. Butler describes in an interesting manner the prevalence of centres of root infection which radiate from rotting stumps, and from stumps of some species of trees more frequently than others.—(*Nature*, No. 3095, Vol. CXXIII.)

SUGAR OUTLOOK FOR 1929.

According to the United States Department of Agriculture, Bureau of Agricultural Economics, the sugar outlook for 1929 shows that prospects point to a continuation of large world sugar production, with sugar prices at a low level through another year. Prices may not go lower than in 1928 in which they have averaged the lowest in any year since the war. In recent months wholesale prices at New York have been the lowest since January, 1922. Any further decline might result in some curtailment in the grindings of sugar-cane and ultimately in higher prices.

Reports to date indicate that world sugar production for the present season will be four per cent. in excess of last season. Sugar consumption is increasing, but probably not rapidly enough to absorb the additional supply without leaving some increase in stocks at the beginning of this season. There is no evidence that the world-wide tendency to expand production in both cane and beet producing areas has been checked, consequently producers in the United States may expect as great, if not greater, competition from foreign producers next season than they are experiencing in the present season. Under these conditions, domestic sugar producers can hardly expect improvement in the demand for their product next season.

The visible supply of sugar in the most important sugar-producing countries at the beginning of the current sugar-producing seasons was more than 100,000 short tons greater than the visible supply at the corresponding dates in 1927-28. Estimates to date, for the 1928-29 season, indicate that the world production will be about 29,452,000 short tons of raw sugar, an increase of 1,216,000 short tons, or four per cent. over the 1927-28 season. Adding the increase in visible supply to the increase in the crop provides a total available supply of about 1,300,000 short tons of sugar in excess of the supply available last year.

The prevailing low prices of sugar encourage some increase in consumption, but prices have been low through the past four years, and the annual consumption of raw sugar in the United States at present appears to be only about 1,122,000 short tons, or 16 per cent. more than it was four years ago. Although consumption in Europe has been increasing, world consumption can hardly be expected to increase in one year enough to use an increase of 1,300,000 short tons in supplies.

Production of both cane and beet sugar in foreign countries continues to expand. The crop of Java has been increasing continuously since 1919; the present crop is estimated to be one-half million short tons in excess of last year. Cuba is also harvesting a record crop. No official estimate has been made, but the trade estimates the crop at 5,320,000 short tons, an increase of nearly 800,000 short tons over the 1927-28 crop. The removal of restrictions on production will release the entire crop for market unless low prices discourage the grinding of the entire crop. The sugar beet acreage of Europe has more than recovered from the effects of the war. The 1928 area totalled 6,655,000 acres as compared with a pre-war (1909-1913) average of 5,315,000 acres. Low prices may check the rate of expansion but there is no indication of curtailment in the sugar-producing area of any important country.—(*The Planter and Sugar Manufacturer*, Vol. LXXXII, No. 5.)

PEDIGREE STOCK.

The export trade in British pedigree stock, which is mutually valuable to breeders of the best class of stock in Great Britain and to stock raisers in the Dominions and overseas Colonies who wish to obtain the best quality foundation stock, has been seriously interrupted since 1921 by the embargoes which many of the importing Dominions and Colonies have found it necessary to impose with a view to preventing the risk of the importation of foot and mouth disease, in consequence of the outbreaks of that disease which have occurred in Great Britain.

To meet this difficulty, a detailed scheme was submitted to the Empire Marketing Board by the Royal Agricultural Society of England in consultation with the Ministry of Agriculture, and approval was immediately given for the erection of a Quarantine Station in London. Under this scheme, the Royal Agricultural Society of England has undertaken the responsibility of establishing and administering the Station as agents of the Empire Marketing Board. The English Ministry of Agriculture is to be responsible for examining animals before admission to the Station, for visiting and inspecting the animals at least once each day throughout the fortnight's period of quarantine, for providing other official veterinary supervision, and for a final veterinary inspection ensuring a clean bill of health before any animal is loaded on board ship. The Empire Marketing Board is meeting the capital and overhead maintenance charges.

The Quarantine Station was completed and opened in 1928 and is now actually in use. It is situated at East India Dock, London. In choosing this site for the establishment of this Station particular care was taken to select a place so isolated as to eliminate any risk of the introduction into the Station from outside sources of any infection from ordinary causes. Rigid conditions have been laid down by the Minister of Agriculture and Fisheries of Great Britain in an Order entitled the Quarantine Stations (Regulation) Order 1928, and in certain rules for the control of the Station in order to ensure the healthy condition of animals admitted to and shipped from the Station, and to prevent infection entering the Station either by persons, animals, or materials.—(*Journal of the Council for Scientific and Industrial Research*, Vol. I, No. 6.)

"FERTILE SOILS."

According to the Concise Oxford Dictionary, the word "fertile" means "bearing abundantly," or "fruitful"; so that, if a soil bears a luxuriant crop of weeds it is fertile—relative to the weeds. Likewise, if it carries a large stand of timber to the acre it may also be said to be fertile—relative to the trees. But it by no means follows that such a soil is fertile relative to any given agricultural crop.

The word fertile is a much abused term and the phrase "fertile tropical soils" has done more harm than most catch phrases. Such soils very often are fertile relative to the forest growth, but the phrase is commonly used by the speaker with a vision of flourishing agricultural crops at the back of his mind. What is really meant in such a case is not a fertile soil but an intrinsically good agricultural soil. And though a good agricultural soil must by definition be fertile, the converse is by no means true.

A soil really deserving the adjective "good" must be efficient physically, chemically and biologically; physically, as concerns texture and water supply; chemically and biologically, as regards food supply. All these of course are interrelated. Forests will often thrive on soils which, judged from an agricultural standpoint, have a very low standard of efficiency, particularly from the physical and chemical standpoints. Such soils are fertile relative to the trees, but, to bring such areas under agricultural cultivation is a very expensive business, practically involving making new soils. Given a sufficient pressure of population and a concomitant "land hunger," it can be done. Otherwise without such pressure, and with cheap land, it only too often means felling and burning, then gaining a few years' crops on the residue of the burn, after which the area more or less rapidly becomes covered with a retrograde form of bush. As Mr. Walters states in his article on "St. Lucia Banana Lands" in the March number of *Tropical Agriculture*,

> "It is clear that such (forest) soils cannot "be treated in a haphazard fashion; they must "be worked or they will deteriorate rapidly, "and one of the conditions of opening up "land successfully is that a good standard "of cultivation must be maintained."

But whether a soil be good and worthy of being brought under agricultural cultivation, or poor and economically better when kept in forest, under Trinidad conditions, the simple removal of the forest growth leads to rapid soil deterioration. It may not be inapt to look upon the forest canopy as a living mulch. In forestry work when regenerative operations are undertaken which involve exposing the soil, the big objective is always to form canopy as soon as possible. Good silviculture is intimately concerned with preserving the fertility of the soil.

> "The principal fact is that the activity of "the soil and a vigorous development of "the crop growing on it are intimately "connected with each other, and that the "one exercises a healthful effect upon the "other. At the same time, their requirements "are sometimes opposed to each other, "and in such cases it must be a leading "principle that the tending of the crop "should always aim at a proper preservation "of the fertility of the soil (Schlich *Manual "of Forestry*, Vol. II, Silviculture").

Forestry work cannot afford manures and mechanical soil cultivation. The forester has to handle his trees in such a way that the soil is kept in good condition. He has known for ages that to effect this, the main thing is to form a good canopy.

What he does not know—particularly with tropical soils—is exactly what goes wrong when the forest cover is removed. This is not to say that many observations have not been made on the effect of the removal of the forest canopy, but rather that the fundamental "whys" and "wherefores" have yet to be elucidated.

Thus from a forestry standpoint the investigation (referred to in the editorial of the March number) now being carried out on tropical forest soils in Trinidad is particularly welcome.

The writer agrees so wholeheartedly with the concluding paragraph thereof that he would fain repeat it. "To proceed with the wholesale "exploitation of our tropical forest lands without "at least an appreciation of these fundamental "problems is to court disaster if not wantonly "to waste one of Nature's greatest gifts."

R. C. M.

AMERICAN COTTON CROP.

The United States Government's final report on the cotton crop for the season 1928-29, gives the amount ginned as 14,269,000 bales, against 12,955,000 bales a year ago, and 17,755,000 bales in 1926. The statement published was rather below expectations, and, on the figures becoming known, prices in New York and Liverpool advanced several points. It should be mentioned that, on 8th December last, the Government estimated the crop at 14,373,000 bales, and up to 15th January the amount ginned was 13,892,000 bales. Owing to big world consumption the statistical position of the article has recently been stronger, and the visible supply is declining from week to week. On the other hand, traders anticipate that at present prices farmers will make every effort to produce a big growth this summer, and there is every expectation of a fair increase in the area under cultivation. The extent of the growth will depend upon the weather later on, but it is recognised that, if higher prices are to be avoided, there will have to be an indication of a yield of not less than 15 million bales. Recently heavy rains in the belt have delayed farm work, but drier conditions are now reported.—(*The Economist*, Vol. CVIII, No. 4, 465.)

TROPICAL WORLD NOTES.

Madagascar.

As a result of a botanical expedition to Madagascar, Dr. Charles F. Swingle, Botanist of the Bureau of Plant Industry, brought back 23 lots of plants which seem to have some value as potential sources of rubber. Ten of these are now being commercially exploited for rubber in Madagascar. Some of them have been introduced previously into the United States and are now being tested in the department's experiment garden in Southern Florida, but undoubtedly several are entirely new to the United States. The southern part of Madagascar, which lies just outside the Tropics in the South Temperate Zone, is like parts of the south-west of the United States in many respects and the Bureau hopes that some of these new rubber plants may be adapted there.

Apparently the real prize of the expedition consists of live specimens of *Euphorbia Intisy*, an almost extinct species of rubber-yielding plant. Twenty-five years ago the rubber from this plant was highly prized in France for making automobile tyres. But the high value of this rubber spelled the doom of the species as a commercial one, at least for the time, for the natives collected the rubber so ruthlessly that even most botanists acquainted with Madagascar feared the species had become entirely extinct. The Humbert-Swingle expedition found some of these plants growing in an arid region, subjected yearly to six months without rain and sometimes to drought lasting as many years. This plant, which is almost leafless, is able to withstand these extremely arid conditions by having a water-storing root system of unique type.—(*Science*, Vol. LXIX, No. 1784.)

* * *

Punjab.

Katha is still the variety of sugar-cane according to the Report of the Department of Agriculture (Part I 1928) most commonly cultivated throughout the province but the area under Coimbatore canes is spreading rapidly. In many of the principal cane growing districts, and particularly in Karnal and Rohtak, the improved Coimbatore varieties are grown on large areas. In certain villages in these districts the entire sugar-cane area is under Co. 205. From the various experimental farms of the Department Co. 205 and Co. 223 were sold to zamindars for seed purposes, as far as they could be supplied. Experiments on the Department's farms over a number of years have proved clearly that these canes are markedly superior in yield of gur to the local canes commonly grown. The total estimated outturn of gur in the province was 337,800 tons, or about 11.6 per cent. more than that of the preceding year.

In the Gurdaspur circle the two Coimbatore varieties Co. 205 and Co. 223 continue to give good results and are rapidly replacing the Uba type which until recently held the field. The Uba cane being a soft type is more susceptible to disease and suffered badly from frost last winter.

Two new district demonstration farms at Gurgaon and Gujranwala were opened early this year. These farms will not only be models in themselves but propaganda centres and seed distributing agencies, and will also attend to one of the most effective means of introducing better agricultural methods, namely working demonstration plots in villages on the peasant's own land. Other interesting new projects completed or approaching completion to promote agricultural efficiency include the construction of a properly equipped insectory at the Punjab Agricultural College, Lyalpur, at a cost of Rs. 60,000, the acquisition of 237 acres of land for the extension of the Gurdaspur Agricultural Station to 500 acres at a cost of Rs. 94,800 and the establishment of a seed farm, costing Rs.50,000 at Fitna.

* * *

Portuguese East Africa.

In Mozambique, Portuguese East Africa, the sugar industry seems to have a splendid future. While the whole problem of marketing sugar is to the fore and an excess production is complicating matters in various corners of the earth, Mozambique is forging ahead to produce sugar because she has climatic and soil conditions that are favourable and some versatile aggressive minds intent upon developing the latent possibilities.

The sugar plantations are found along the fine rivers of this section and the Zambesi Valley with its Buzi and Incomatis Rivers is the centre of interest. The Inhambane region also has a considerable area devoted to cane.

Mozambique produces 60,000 tons of sugar annually. With a stepping up of the mechanical arrangements this tonnage can be increased. The inhabitants consume only about 10 per cent. of the amount produced and the rest of the sugar is exported. The country also receives some foreign sugars but these only amount to about 25 tons. The Sena Sugar Estates produced 42,500 tons of sugar, the Companhia Colonial do Buzi about 5,000 tons, the Incomati Sugar Estates 10,000, the Mutamba Estates about 1,500 tons and the sugar factory at Antonio Teixeiro Dias only 33 tons. The largest factories are controlled by British interests and capital as the names indicate. The Germans have also some interests.

The Portuguese markets are where this sugar finds its largest access. Portugal needs about 75,000 tons a year and its colonies produce about that amount. Portugal imported 72,000 tons in the past year, and of this amount Portuguese East Africa sent 35,000 tons and Portuguese West Africa sent about 8,000 tons. Portugal also imports from Europe, the German supplying about 20,000 tons, Czecho-Slovakia 10,000 tons. Belgium, Holland and England 2,500 tons.—(*The Planter and Sugar Manufacturer*, Vol. LXXXII, No. 6.)

REVIEWS.

The Handbook of the British West Indies, British Guiana and British Honduras 1929-30, Price 5*s*. By Sir Algernon Aspinall, C.M.G., C.B.E. *West India Committee*, London.

This Handbook is a revised and enlarged issue of the 1925 edition and forms a useful book of reference to persons proposing to visit the West Indies. Unlike *The Pocket Guide to the West Indies* by the same author, it has not been compiled solely for the tourist and casual visitor, but is designed to give useful information to persons who are either resident in this part of the world or who are interested from the point of view of business, or political economy.

The first part gives an amount of general information about the various colonies in a very compact form. Other sections of the book are concerned with the various attempts that have been made to obtain co-ordination and co-operation between the several Governments and such matter as currency, customs, subsidies, communications, &c., are dealt with.

A short account of the history and functions of the Imperial College of Tropical Agriculture is given and also an account of Government Departments and semi-official institutions such as the West India Committee, that are intimately connected with the Caribbean area.

This is a useful Handbook and one that will need revising and bringing up to date at frequent intervals in view of the rapid changes that are taking place in this portion of His Majesty's Colonial Empire.

G. E.

* * *

Pitman's Economics Educator. Edited by J. H. Jones, M.A., Professor of Economics, University of Leeds. (To be complete in about 30 fortnightly parts, 1*s*. 3*d*. per part.)

The post war gush of fortnightly Outlines of Everything has already been sufficient to stimulate the humourists of *Punch* to ribaldry. Some are good, others not so good. Judging from the first number—in which series of articles on Production, Distribution, Currency, Banking and International Trade are begun—this one promises to be excellent. Professor Jones and his collaborators see to it that the matter is well written and informative, and Messrs. Pitman—with their eye on the market—rightly believe that 'the work will afford a thoroughly modern and complete preparation' for the various economics examinations that have been devised to worry the modern youth and make him more informed than his father. People in the tropics will find the work interesting, but many of the sections are naturally written with regard to conditions in industrial areas and temperate climates.

G. W.

Laboratory Manual of General Microbiology. By E. B. Fred, Ph.D. and S. A. Waksman, Ph.D. *McGraw-Hill Book Co.* Price $2, pp. 145.

This book is a very useful laboratory guide in four parts, specially adapted to the needs of students taking an elementary course in soil microbiology. The first part describes the preparation of one hundred and eleven different media used in the culture of fungi, yeasts, actinomycetes and the various types of bacteria. The rest of the book deals with the staining of bacteria, methods of qualitative and quantitative analyses (brief), and the isolation, culture and the estimation of micro-organisms connected with the soil.

A. K. B.

* * *

Immigration Restriction. By R. L. Garis. *The Macmillan Company, New York*, pp. 376. Price 17*s*.

After an account of the early history of the subject Mr. Garis summarises the successive steps taken by Congress for restricting and regulating the entrance of aliens. The first general immigration law was passed in 1882, since when once a ban has been put up it has never been removed. The Immigration Act of 1917 opened an era of even greater stringency which was intensified in 1921 by the introduction of the Quota system. In 1917 the door was effectively closed against the immigration of Hindus, as well as Chinese and Japanese by the so called "latitude and longitude" plan. The publication of the work is evidence of the prominent place that the immigration question has come to occupy among American problems.

G. W.

* * *

On the recommendation of the Imperial Agricultural Research Conference of 1927, the Ministry of Agriculture, 10, Whitehall Place, London, S.W.1, have recently issued two publications, price 1*s*. each, directly affecting Empire Research workers. The first of these contains particulars of:

(1) Institutions carrying out agricultural research, with the names of the principal members of the staff, a short appreciation of fields of research, and an account of facilities for research.

(2) The names of University professors in pure sciences cognate to agriculture, arranged under the respective sciences.

(3) The names of professors, readers and lecturers in agriculture and cognate pure sciences at the various universities, &c., at which agricultural research and teaching are carried out.

The second is a revised List of Agricultural Research Workers in the Empire.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The Penetration of Lime into the Soil.

The depth to which lime influences soil reaction and the calcium content of the soil after it has been applied to the surface is a matter of great importance. Conflicting data have been obtained by past workers. A further series of experiments suggests that little penetration to the lower layers of the soil occurs. A series of pasture plots were manured with different manures, and ground limestone at the rate of one ton per acre applied to the surface. After six years, soil samples were taken every three inches down to one foot. The samples were examined for calcium content and acidity. With the exception of the unmanured control plots, no significant increase in calcium content was obtained beyond the first three inches. That the influence of the limestone had been felt at lower layers was shown by a slight decrease in acidity, even at nine inches. The change in pH value in the first three inches was from pH 4.8 (unlimed) to pH 5.7 (limed) and in the six to nine inch layer from pH 4.8 to pH 4.9.

Potassium chloride and acid phosphate had no influence on the soil acidity while gypsum had a slight neutralizing effect.

The results seem to indicate that when possible it is advisable to plough in lime after application. —(*Soil Science*, XXVII, 143.)

* * *

The Relationship between Vitamin A Content and Colour in Maize.

Vitamin A is usually present only in those seeds which contain a yellow cartinoid pigment. Thus, yellow varieties of maize are known to contain adequate vitamin A for ordinary nutrition while the white varieties are notably deficient. It is suggested that the relationship between the vitamin content and the colour may be only genetic. If so, it should be possible to transfer the vitamin characteristic from the yellow variety to the white. This possibility has been studied by crossing a variety with a yellow endosperm kernel and a variety with a white endosperm kernel. The resulting corn from each cob was separated into two groups of seeds, having yellow and white endosperms respectively. Each group was tested for vitamin A content by feeding it to rats. In no case did the grains with white endosperm supply vitamin A to the diet, while all those grains possessing yellow endosperm had equal contents of the vitamin.

The determination is of importance to growers of white corn and to cattle farmers who use maize as a feeding stuff.—(*Journ. Biol. Chem.*, Vol. LXXX, No. 107.)

Vitamin B Content of Avocado Pear.

The avocado pear is known to be highly nutritious and to contain several essential vitamins. Recently, further determinations have been made of the amount of anti-neuritic and growth-promoting vitamin B in the fresh fruit. The content was determined by feeding albino rats on a diet deficient in vitamin B with the addition of weighed quantities of pear. Fleischmann's dry yeast was used as a standard of comparison. By using varying amounts of pear on different rats it was estimated that approximately three grams of avocado pear were equal to 0.25 grams of yeast. Since the average weight of the edible part of a pear is twelve ounces, one avocado pear is equivalent in vitamin B content to one ounce of dry yeast. Determinations of vitamins A, C, D and E in avocado pear are under investigation.

* * *

Recent European Fertilizer Developments.

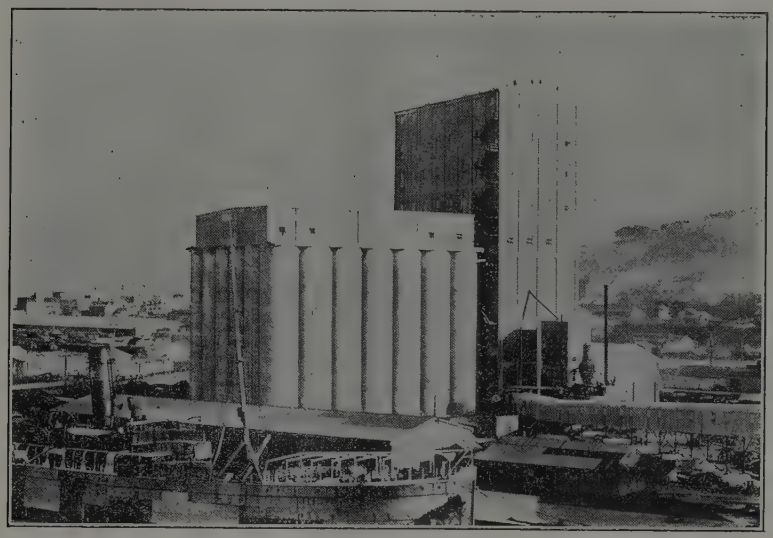
The world's consumption of fertilizers is controlled by economic factors, by the influence of scientific research, and by the trend of fashion. Research in showing the need for fertilizers and in increasing their production has caused a tremendous increase in the use of fertilizers since 1913. An analysis of the total shows that the increase is due entirely to greater consumption of nitrogen and potassium fertilizers. The amount of phosphates consumed is practically unaltered. The advent of synthetic ammonia compounds and of cyanamide and the great amount of advertisement they have received, have caused largely the great increase in the consumption of nitrogenous fertilizers. Germany is now entirely dependant on synthetic products and imports no Chilean nitrate. Nevertheless, the annual consumption of Chilean nitrate throughout the rest of the world is practically constant. The large increase in the total consumption is therefore due entirely to synthetic products.

A comparison of the consumption of individual European countries shows that the increase is due to Germany, France and Holland. Great Britain uses approximately the same amount of fertilizer now as she did twenty years ago.

An estimate of the average yield of crops per acre in various countries shows that in Germany, in spite of a large increase in the use of fertilizers, there has been a fall in yield of 14 per cent. since 1913. In France there has been an increase of 9 per cent. It is suggested that the fall may be due to a lack of phosphate application. Inclement weather, and the fact that much poor land was brought into cultivation during the war and is now producing small yields may also contribute to the decrease. It is significant that all the crops have declined.

The use of complete fertilizer is increasing. In Great Britain more than half the total fertilizer used is previously mixed in the factory.—(*Ind. and Eng. Chem.*, XXI, 375, 1929.)

AGRICULTURE IN SOUTH AFRICA.



A Grain Elevator.

Maize and Wheat Production. The Circles represent Grain Elevator Centres.

ST. LUCIA.

Engraved by *Tucker Picture Co.*

View of Cul de Sac Valley.

Engraved by *Tucker Picture Co.*

View of Castries.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Determination of Sulphur Dioxide in Sugar, using the Sulphide Stain Method.

J. M. BRYAN (*Analyst*, 1928, 53, 589-590) proposes the following modification of J. S. Mann's "sulphide stain" method as being extremely sensitive:—The apparatus which is similar to that used in the *Gutzeit* test for arsenic, comprises a tall glass bottle of about 150 cc. capacity, into which is fitted by means of a waxed cork a tube (15 cm. by 12 mm.), having a constriction about one-third of the distance from the top, to receive a plug of cotton wool. This tube is also provided with a waxed cork through which passes a tube (15 cm. by 5 mm. bore) constricted 7 cm. from the top to retain the test slip in position. The lead acetate test papers are prepared by soaking English filter papers in a 25 per cent. solution of neutral lead acetate, drying them in air, and then cutting them into strips (6 cm. by 4 mm.); these strips are kept moist by placing them in a desiccator in which the usual dehydrating agent is replaced by wet pumice. After each test the lower tube should be dried and a fresh plug of cotton wool inserted. In making a test 25 grams of zinc pellets (free from sulphur) are placed in the bottle, and washed with dilute hydrochloric acid, followed with air-free distilled water, and the sugar sample introduced. 50 cc. of hydrochloric acid (1:1) are added, and the connection at once placed in position. After a few seconds the bottle is shaken gently, and then allowed to stand for one hour, after which the test paper is removed, dipped in molten paraffin, and compared with standard stains. The sample taken should be of such a size that the stain falls within the scale of standards given below.

Preparation of the Standard Stains:—Saturate air-free distilled water with sulphur dioxide from a syphon; dilute this solution to a convenient strength with air-free distilled water, and determine the sulphur dioxide present by means of N/20 iodine solution. From this prepare five solutions containing 0.0001, 0.0002, 0.0003, 0.0004, 0.0005 grm. of sulphur dioxide, respectively, and 10 grams of pure sucrose per 100 cc.

Air-free distilled water must be used and every precaution taken to prevent any oxidation of the sulphur dioxide during manipulation. Standard stains corresponding to 0.005, 0.010, 0.015, 0.020, 0.025 mgrm. of sulphur dioxide will be obtained when 5 cc. of each of the above solutions are used in the apparatus. Since the test is also applicable to the determination of traces of hydrogen sulphide, it is probably advisable to express the stains in terms of sulphur.

Attempts were made to differentiate between the sulphur in the two forms, but no satisfactory method was evolved. It was noticed that more intense standard stains were obtained when sulphur-free sugar was present than from plain sulphur dioxide solutions. Probably the sugar prevents displacement of sulphur dioxide by the hydrogen before reduction has occurred. When standard stains were prepared under these conditions with known amounts of hydrogen sulphide and sulphur dioxide, a comparison showed that one part of hydrogen sulphide was approximately equivalent colorimetrically to two parts of sulphur dioxide, thus indicating that complete reduction of the sulphur dioxide had occurred. It is necessary to carry out a "blank" test, and it is obvious that the quantity of the sample required in the test will vary according to the amount of sulphur dioxide present. Thus when one part per million of sulphur dioxide is present, 10 grms. of the sugar will be found convenient, whereas when there are 20 parts per million only 1 grm. is necessary; hence a preliminary trial should be carried out to ensure that the stain may fall within the prescribed range of standards. (*International Sugar Journal*, Vol. 31, No. 364, p. 220.)

* * *

Extraction of sugar and potassium salts contained in molasses. T. Gasper y Arnal. (*Anales soc. espan. fis. quim* (*Tecnica*) 26, 73-80 (1928).)

The potassium in beet molasses is precipitated by adding 20 per cent. of $Ca_2Fe(CN)_6\ 12H_2O$ on weight of molasses, and heating to 70° for 0.5 hour. The ferrocyanide is used in a solution of 40 per cent. concentration. The precipitate of $K_2CaFe(CN)_6$ is filtered off, and the sugar in the filtrate recovered by the usual methods. The yield is about 64 per cent. of the sugar in the original molasses. The final mother liquors from the sugar crystallization may be utilised for the isolation of valuable non-sugars contained in them. The precipitate of $K_2CaFe(CN)_6$ is treated with $Fe_2(SO_4)_3$, yielding a precipitate of Prussian blue plus $CaSO_4$ and a solution of K_2SO_4 with some $CaSO_4$ and excess $Fe_2(SO_4)_3$. This solution may be dried and sold as a fertilizer, or worked into high grade potassium salts. The Prussian blue is decomposed by heating gently with milk of lime. The precipitate of $Fe(OH)_3$ is filtered off, and again converted into $Fe_2(SO_4)_3$ to be used over again. The solution of $Ca_2Fe(CN)_6$, with a slight excess of $Ca(OH)_2$, is concentrated and used again for precipitating potassium salts. If necessary, the excess $Ca(OH)_2$ may first be removed by treatment with CO_2. The only chemicals not recovered are $Ca(OH)_2$ and H_2SO_4, and only the operating loss of the others has to be replaced. "The process is simple and very economical since the equipment is very elementary and the recovery reactions are such as have long been regarded as quantitative." No data are given on actual factory operation. — (*Chemical Abstracts*, 1929.)

TOPPING OF COFFEE.

T. B. McClelland (*Bull.* No. 32, *Porto Rico Agric. Exper. Sta.*), gives the results of some experiments to determine the effect of topping coffee trees on the yield of coffee. Tests were carried out beginning in December, 1910. The variety used was Blue Mountain of Jamaica, which is typical of the ordinary *Coffea arabica*. The trees were set in 24 short rows of unequal length. Rows 1 and 2 were left untopped, rows 3 and 4 were topped at 6 feet and rows 5 and 6 at 4 feet. The remaining 18 rows were treated in the same alternating sequence. The first of each of the four pairs of untopped rows received no pruning, all suckers and growth of every kind being allowed to develop freely. In the second of the untopped rows suckers were removed, so as to restrict the growth to the single original stem and developments from its laterals.

Topping forced the growth of many new uprights or suckers. These were periodically removed so as to keep the growth to the single stem and branches developing from its laterals. It was found that the picking of the crop from the topped trees was greatly facilitated, as the fruit was produced on low branches within easy reach of the pickers.

The yields of the trees were recorded over a ten-year period, 1912-21. For this period as a whole, the trees which were held to a single stem and those which were topped at 6 feet produced only 74 per cent. as much as the unpruned trees, whilst those topped at 4 feet produced only 58 per cent. as much. The depressing effect on production exercised by severe pruning or topping was less evident in the early years of the test than later. Thus in the three-year period 1912-14, the trees which were topped at 6 feet, and those which were held to a single trunk, produced each year within 10 per cent. of the yield of the unpruned trees. But in the seven following years, the same trees gave a yield equal to only two-thirds of that of the unpruned trees, whilst the trees topped at 4 feet gave only half as much as the latter.

It is, therefore, considered that whilst the topping of coffee trees considerably facilitates the collection of the crop and contributes to the uniform and well-kept appearance of the plantation, these advantages do not compensate for the heavy loss of crop entailed. It is pointed out, however, that although in the tests the wholly pruned trees gave the highest yield, the inference that no pruning is advisable should not be made. Ordinarily suckers are produced in such numbers as to make the removal of some of them very desirable.—(*Bulletin of the Imperial Institute*, Vol. XXVII, No. 1, 1929.)

EXPERIMENTAL ERROR.

Dr. Maskell's article on "Experimental Error" can be obtained on application to the Editor in the form of a special reprint, price 1s.

COLLEGE NEWS.

Mr. F. L. Engledow, M.A., of the School of Agriculture, Cambridge, sailed for England by s.s. *Bayano* on 3rd May.

* * *

Miss R. Agostini, Senior Assistant in the Editorial Department, sailed for Canada by s.s. *Pan America* on 3rd May for three months' sick leave.

* * *

Mr. H. A. Ballou, Professor of Zoology and Entomology and Commissioner of Agriculture for the West Indies, sailed for St. Lucia by s.s. *Dominica* on 7th May and returned by s.s. *Lady Nelson* on 16th May.

* * *

Dr. Mary V. F. Beattie, M.B., Ch.B., arrived from England by s.s. *Carare* on 19th May. Dr. Beattie who is a Research Fellow of the London School of Hygiene and Tropical Medicine, will make her headquarters at the College, where she will conduct an enquiry into the breeding places of mosquitoes.

* * *

Amongst recent visitors to the College were Sir Edward and Lady Davson, Professor F. Aereboe, Berlin, Lieut.-Colonel T. T. Behrens and Messrs. C. C. Skeete, Acting Director of Agriculture, Barbados; L. D. Cleare, Jnr., Entomologist, Department of Agriculture, British Guiana, J. Gardner McLean, H. Hudson and P. J. Darlington, of Harvard University.

* * *

A meeting of the Trinidad Science Club was held on 25th April when Captain H. V. Metivier lectured on "Livestock in the Tropics." Another meeting took place on 9th May when Mr. S. M. Gilbert, who has recently been appointed Assistant Director of the Trinidad Department of Agriculture, gave an address illustrated by photographs entitled "An Agricultural Officer in Nigeria."

COLONIAL APPOINTMENTS.

The following appointments and transfers have been made by the Secretary of State for the Colonies during the month ending 31st March, 1929.

Mr. H. H. Whittaker, Native Lands Commission Surveyor, Fiji.

Mr. W. H. Edwards (Lecturer in Entomology and Zoology of the College of Agriculture, and Acting Botanist and Mycologist, Mauritius), Entomologist, Jamaica.

Mr. S. M. Gilbert (Superintendent of Agriculture, Nigeria), Assistant Director of Agriculture, Trinidad.

Mr. A. Pitcairn (District Agricultural Officer, Tanganyika), Assistant Director of Agriculture, Cyprus.

EASTER TOUR TO ST. LUCIA.

It has now become the accepted custom at the College that one of the short vacations should be employed by post-graduates in visiting a neighbouring colony with the object of getting some first hand knowledge of the difficulties and problems that the limited agricultural staff of one of these small islands is faced with.

During the recent Easter vacation a party of fifteen Colonial Office cadets together with the Dean and the Principal visited St. Lucia and was away from the 26th March to the 8th April. The voyage north was made in the *Lady Nelson*, one of the magnificent new ships of the Canadian National Marine. Brief stops were made at Grenada and St. Vincent and opportunity was afforded to visit the famous old Botanic Gardens at the latter island when the whole party was conducted round by Mr. Jackson, the Agricultural Superintendent, and afterwards enjoyed his hospitality.

On account of the Easter holidays, the ship stayed for two and a half days in Barbados, and thanks to the courtesy of the Acting Director of Agriculture, Mr. C. C. Skeete, and other members of the Department every facility was afforded to study some of the interesting lines of work that are being pursued by the Insular Department. Particularly instructive were the experiments that are being carried out on the biological control of cane borer *Diatraea* by means of *Trichogramma*, which have now reached an advanced stage.

Five days were spent in St. Lucia and in this short space of time, a full programme of work was carried out, thanks to the excellent arrangements made by the local officials. Visits were made to the Union Estate which is now being established as an experimental station in place of the Reunion Station in the south of the island, the latter being on unsuitable soil and also somewhat inaccessible. This visit was a particularly valuable experience to the more junior men, as they were able to gain some idea of the difficulties that are liable to arise when an experimental farm has to be carved out of forest and more especially when funds are strictly limited.

Sugar estates were visited at Cul de Sac and Dennery and numerous lime and coconut estates inspected both in the wet belt at Souffrière and in the drier parts of the colony. The lime industry is an important one in St. Lucia, and the advent of "withertip" disease a few years ago was the cause of consternation and depression. The attempts that are being made to counteract this disease naturally proved most interesting and instructive to students of tropical agriculture. In one or two instances as for example, in the Marquis Valley, the limited use of irrigation water in the dry season had caused the lime trees to flower and set their fruit before atmospheric conditions became too humid to favour the rapid spread of the "blight."

In other cases it was suggested that limes growing under leguminous shade trees did not suffer so much from this disease. These and other problems such as the encouragement of budding on deep rooted stocks resulted in many profitable discussions. The extension of coconut cultivation and the possible introduction of coffee as an auxiliary crop following on the failure of banana cultivation on a commercial scale, also were discussed.

The inhabitants of St. Lucia everywhere extended their hospitality and the consequence was that an enjoyable time was spent more especially as the whole period of this visit was favoured with exceptionally fine weather. Time was found to pay a brief visit to the "Souffrière" boiling springs, and few of those present will forget the "exhilarating" trip back in the dark by the *Lady Joan* along the so-called Leeward coast!

The thanks of the party are due to Mr. C. W. Doorly, the Administrator, and Mr. E. A. Walters, the Agricultural Superintendent for all the excellent arrangements made and also to the numerous ladies and gentlemen who by their hospitality and kindness helped to make our stay such a pleasant and profitable one.

G. E.

TANGANYIKA TERRITORY.

Agricultural Development during 1928.

The usual history of the growing season in the Territory repeated itself: insufficient rains in most areas at the beginning, followed by more or less regular rainfall that saved the situation; thus no shortage of food crops was suffered, save in restricted areas. The Bukoba, Mahenge and Eastern Provinces experienced the best season, their respective outputs of coffee, rice and cotton being far above the average in each case.

Of the chief native cash crops other than coffee (dealt with later), namely groundnuts and cotton, the former suffered again a setback, owing to an unfavourable season especially in Mwanza; so that the total export of groundnuts was only 10,595 tons as against 14,147 tons in the previous year. In the case of cotton, on the other hand, a good season (except in Mwanza) and the better prices of the previous year brought the export for 1928 beyond that of 1926, actually to 27,402 bales. The two products of first importance in the Territory, namely, sisal and coffee, maintained their position with increases from 33,012 to 36,186 tons and 6,595 to 10,431 tons, this large increase in the case of coffee being entirely due to the phenomenal output in Bukoba, nearly double that of the previous year, or 7,832 tons as against 3,944. Work with tobacco, coffee and tea by European planters in the South-western area continued; but the question of the extent of development of these and other suitable crops in this region must await the results of the economic survey that is being made by the Departments concerned, in the Iringa Province.—(*By courtesy of Department of Agriculture, Tanganyika.*)

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

Sugar.—Prices on the Home Markets have ranged as follows (*c.i.f.* per cwt.).

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
6th April	9	1½	12	10½
13th April	9	3	12	10½
17th April	9	4½	13	0
22nd April	9	1½	12	9
1st May	9	0	12	9
9th May	8	10½	12	8¼

The course of the market has been somewhat disappointing to sugar holders. According to *C. Czarnikow Ltd.*, "at the beginning of April there were all appearances of the article being on the eve of a spell of firmness owing to the near approach of the Budget announcement which was expected to be followed by good general buying of Refined, and the commencement of the special Session of Congress in America on the 15th of April for the consideration of the Farm Relief Bill and Tariff Legislation, presented by United States farmers with the object of securing better protection to grow more beet." The absence, however, of any alteration in the British Sugar duties deprived the home market of any speculative disturbance and President Hoover's first message to Congress indicated that whatever the outcome of the Tariff discussions, negotiations are likely to be of a protracted nature. A quieter time has in consequence generally prevailed with prices showing a sagging tendency.

* * *

Cotton.—According to the *Times Trade and Engineering Supplement*, 20th April, Mid-American is quoted at 10.64*d*. Prices have given way generally during the week on favourable weather in the belt, which has restrained buying and kept up a small but steady flow of long liquidation, with resultant easing in prices. Sea Island has been in limited demand without change in quotations at fair 23*d*; fine 27.50*d*.; extra fine 38*d*.

* * *

Cocoa.—Most attention is directed towards the New York market where the total arrivals for four months up to the end of April are 400,000 bags in excess of 1928 at corresponding date. Spot stocks in New York continue to increase and are approximately 70,000 bags above the figures for the same date last year. Under these conditions manufacturers continue indifferent and, if anything, prices are inclined to decline.—(*By courtesy of Cocoa Planters' Association, Trinidad.*)

Coffee.—A fair business is reported in London. Jamaica quoted at 210*s*. per cwt., Costa Rica at 155*s*., Kenya at 130*s*. Spot Sales include Colombian at 119*s*. to 129*s*., Indian at 128*s*. to 160*s*. and some good Brazilian at 110*s*. per cwt. The price of common No. 7 Rio, has, however, declined from $30.50 in January to $28.73 now.—(*Times Trade and Engineering Supplement.*)

* * *

Tea.—Ceylon average is quoted at 20.22*d*.; Indian average at 18.14*d*. and Java average at 13.63*d*. Following the repeal of the duties the ordinary market for tea has been strong for Ceylon and Indian and a very fair business has been done in Sumatra and Java tea. Java tea is held for a penny advance May delivery. The two sorts still dull are Chinese and Japanese. Averages include 16.82*d*. Sumatra, 13.18*d*. Nyasaland, 21.68*d*. Darjeeling, and 18.76*d*. Assam. Chinese is not averaged, but good Keemum comes at 26*d*. per lb. London stocks of all tea are 237,722,000 lb., of this over 160,000,000 lb. are Indian.—(*Times Trade and Engineering Supplement*, Vol. XXIV, No. 563.)

* * *

Rubber.—Quotations for Plantation Sheet have ranged as follows: 6th April, 11*d*., 13th April, 11¾*d*., 19th April, 9 1/16*d*., 25th April, 9⅞*d*., 30th April, 9⅝*d*., 9th May, 10½*d*. Prices have fluctuated frequently within more accentuated limits. The sharp fall on 19th April was attributed by *Messrs. Symington and Sinclair*, to freer offerings from the East, which in turn has brought about liquidation both in London and New York. They go on to say, "this may be only a temporary phase, but until there are evidences of an actual and definite showing up in Eastern shipments the buying Markets cannot be expected to show much improvement. At the same time it is quite possible for selling to be overdone and short covering might bring about a recovery. Also it must be borne in mind that prices are again reaching a level when Rubber may attract the interest of the speculator

* * *

Copra.—Copra remains dull and the value of West Indian *f.m.s.* is again lower at £22 10*s*. *c.i.f.* London.—(*West India Committee Circular.*)

* * *

Bananas.—Jamaicas are in fair demand and unchanged at £20 per ton (delivered) to wholesalers, and 10*d*. per dozen (carriage extra) to retailers. Brazilians are also in fair request and unaltered at £20 per ton, delivered nearest railway station.—(*The West India Committee Circular*, 18th April.)

* * *

Lime Products.—*Lime Oil.* Handpressed is unchanged with the value quite nominal. The small supplies of genuine Distilled oil imported from regular sources are firmly held. *Lime Juice.* Concentrated is steady with further small businesses at £25 *ex wharf*. Raw is dearer with small sales up to 4*s*. 6*d*. for fine.—(*The West India Committee Circular.*)